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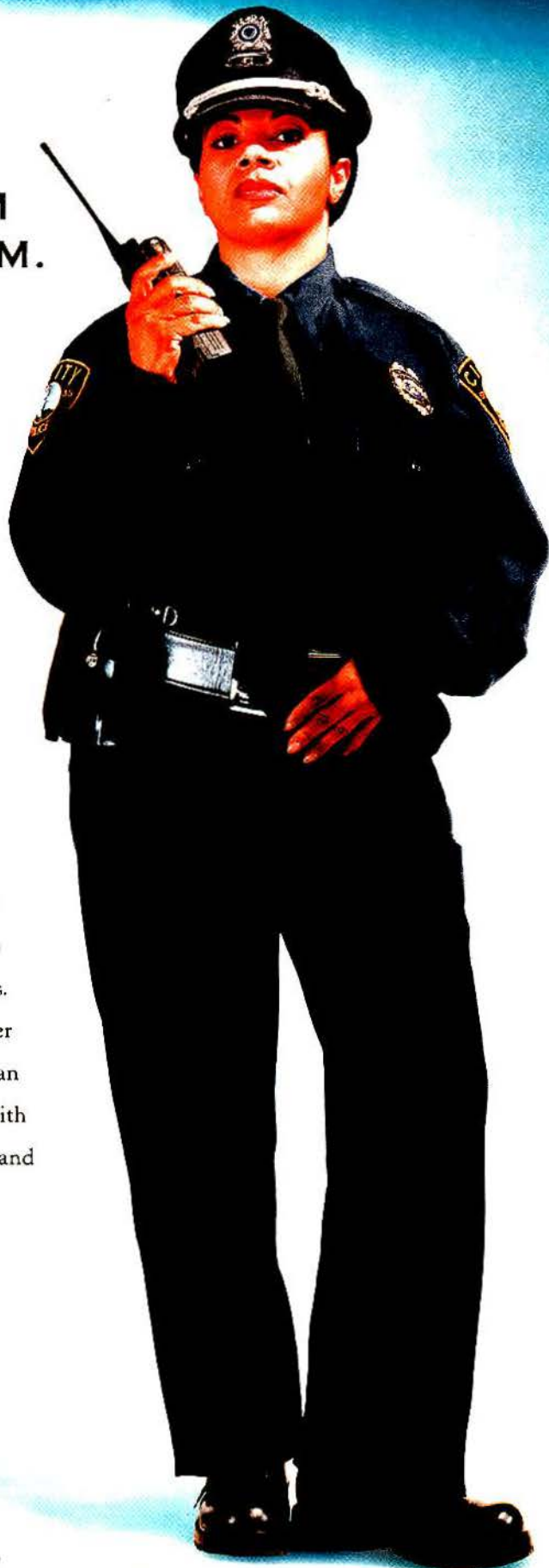
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On the cover: Wanna' play a game? Look at the changes in the paging industry in the past year: Go directly to bankruptcy court or pass 'Go' as a small carrier. See page 30.

APCO takes up the cause to encourage children to call 9-1-1. See page 56.



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James Careless
Boiling down the stock of nearly two dozen radio systems to make one uniform broth isn't easy. The rebirth of the Canadian capital as a new municipality brings a host of public safety radio integration and interoperability challenges.
- 30 COVER STORY: Paging's new game**
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ON THE WEB AT WWW.MRTMAG.COM:



Trade show smarts

George Dennis

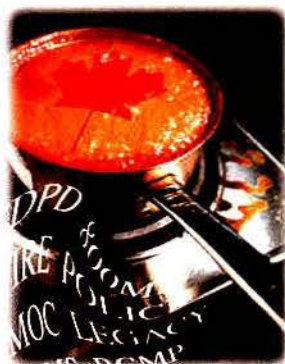
Learn more, lose less at your next trade show.



Morgan O'Brien addresses APCO's national conference

The unofficial text of the speech delivered at the closing banquet.

Ottawa faces the challenge of making 22 radio systems into one in a communications consummé. See page 14.



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CIRCLE (5) ON FAST FACT CARD

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Morgan O'Brien heads 'Nextel Peace Corps'

Nextel: *I hope you'll write something nice about us for a change.*

MRT: *We'd like to.*

That was our witty exchange



with a top-level Nextel Communications official at the APCO International closing banquet on Aug. 9 in Salt Lake City, about an hour before Nextel's vice chairman, Morgan O'Brien, spoke to a dinner audience of delegates and guests.

It's true that we haven't had much good to say about Nextel. We've written about alleged perjury by one of the company's attorneys in a licensing matter; alleged irregularities in the grant of licenses for thousands of frequencies to a Nextel merger partner on a Saturday at the FCC's Gettysburg, PA, office; and the employment by Nextel of former FCC officials (at six-figure salaries plus stock options) who made decisions favorable to the company during their government service.

Nextel boasts of using spectrum-efficient technology to serve eight million customers on SMR spectrum that the company estimates might support one million analog dispatch customers. We disparage the same "accomplishment" because Nextel doesn't use the spectrum to offer the low-cost dispatch service on which business

and industry rely.

Analog SMR operators offer the low-cost dispatch service, but Nextel continues to buy their systems and convert them for wireless telephone service. (At least one other digital SMR offers low-cost dispatch, too, but Nextel seems about to gobble it up.) While possibly uplifting the wireless telephone business, Nextel has made access to affordable radio communications tools more difficult for business and industrial dispatch users.

Those are some of the things we've had to say about Nextel. Is it any wonder the company's media representatives and senior management stopped returning our calls several years ago?

Until the subject of 800MHz interference came up. While covering news about interference from a Nextel cell site that blocked reception of truck drivers' radio calls at a recycling company's office, we left a phone message with Nextel. Just routine. Didn't expect a return call. We were surprised and pleased to get one. The Nextel representatives to whom we spoke didn't want the story to run, but it did, on our Web site, with their comments included.

Nextel is secretive. That's the company's right, of course. For example, it signs SMR operators to non-disclosure agreements covering system retuning projects and system buy-outs. It won't talk much about actions it takes that affect dispatch users.

Refreshingly, Nextel is more open when it comes to 800MHz interference problems, at least when public safety radio systems are involved. Morgan O'Brien stepped right into the lion's den to tell APCO members that the leopard had changed its spots.

O'Brien described Nextel as aggressive and territorial and its legions of lawyers as well-trained, well-disciplined, battle-tested and not afraid of hand-to-hand combat. He went on to explain that, when

it comes to public safety interference, the situation calls for the opposite of the warlike tactics for which Nextel is known.

"I'm here in a new role, which is heading up the 'Nextel Peace Corps,'" O'Brien said.

At his request, Nextel's board of directors has placed O'Brien in charge of resolving interference with public safety radio communications systems. Short-term, that means reprogramming Nextel cell sites. Long-term, that means retuning public safety radio communications systems to frequencies as far removed from those Nextel uses as possible and practical.

Nextel will codify its long-term solution in a pleading before the FCC scheduled for submission in October. At most, public safety agencies, directly or through APCO, should submit proposals of their own. At least, they should file comments when the time comes.

O'Brien: "This is the beginning of the process. You may find me annoying for my persistence. You will learn to trust me and the Nextel team that our motivation is the same as yours. We have the utmost respect for the mission-critical nature of your radio systems and the importance of our participating with you to make sure it continues."

What O'Brien said is good, yet our advice is summed up best in the words of President Ronald Reagan in connection with nuclear arms reduction: "Trust—but verify."

Now, if that wasn't nice, at least it wasn't a knock in the head. Nice comes with evidence of progress.

Don Bishop

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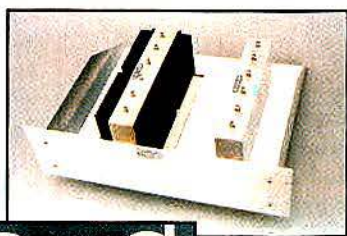
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Peruse the text of Morgan O'Brien's speech on MRT's Web site.

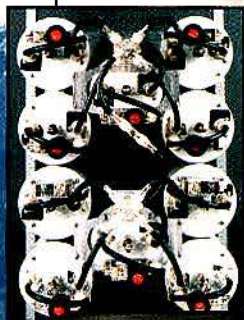


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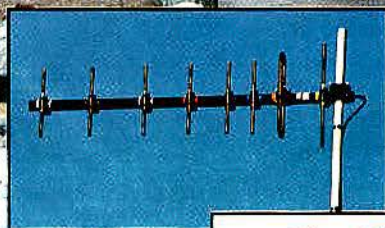
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When are we going to get it?

Have you noticed what is going on north of the border? Lots of hockey, hey. Yes, but the Canadians also seem to get it when it comes to interoperability. Last month's



MRT cover story is a great example, but also look at this month's article, "Ottawa's Communications Consummé," by James Careless on page 14.

I've mentioned before that interoperability is one of my pet peeves when it comes to public safety. In fact, I've mentioned it in every column I've written for *MRT*. And I will continue to be the voice for it. From the response I've gotten from some of you, it's a common concern. Yet, as I look at what is going on in the United States, I just shake my head and start a Dennis Miller rant.

When is interoperability going to become a priority? We don't need another Columbine so everyone can wring their hands, look at each other and comment, "We definitely have to do something. Sometime. When someone else pays for it."

Yet, that is what is happening. Unless we educate decision makers (i.e. state legislatures and Congress) nothing significant is going to happen.

Education is exactly what the National Institute of Justice's Advanced Generation of Interoperability Law Enforcement (AGILE) is trying to do. I had the opportunity to visit with Tom Tolman and Gene McGahey from the Nation Law Enforcement and Corrections Technology Center, Rocky Mountain, who provided me with a review copy of NIJ's Interoperability Resource CD. All I can say is this

CD is terrific.

The CD offers information on radio communications interoperability and information sharing. Included are an executive technology brief, three fundamental guidebooks, a wireless interoperability analysis, information on interoperability projects and tests, glossary and acronyms guides, a Web links section and even a way to get feedback to AGILE.

The CD also features an outstanding article, "Can We Talk?" that is accompanied by a 14-minute video. Whew! Talk about information-packed. They probably included the proverbial kitchen sink if I looked harder.

I applaud the NIJ for this fine effort. It's this kind of product that needs to be targeted at the decision makers. Getting it into hands of law enforcement is one thing, having it in the hands of the decision makers is another.

This issue needs to be on the agenda of every decision maker at the local, state and federal level. Yet, when do we ever hear a peep about the issue unless some misdirected kid gets his/her hands on a gun and creates havoc? Let's start taking the Peter Finch approach (from the movie "Network"), and tell our legislators we are "mad as hell and not going to take it anymore."

Sure, crime may be down in some of our major cities, but how many more lives could be saved if we didn't have to depend on a phone call or other means of communications?

By the way, if you'd like a copy of the CD contact the NIJ at askagile@ojp.usdoj.gov.

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MRT MOBILE RADIO TECHNOLOGY

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CIRCLE (8) ON FAST FACT CARD

A more perfect union

By Robert H. Schwaninger Jr.

When you read this column, it will be around Labor Day, but as I write it, it's the Fourth of July. The two celebrations are linked in several ways.

With the Fourth come friends and families gathered together at picnic tables to eat and light fireworks—and eat—and discuss good times—and eat—and...Well, you get the picture. It's the joining of

who loves horses, grandchildren and conservative politicians—great legs and a great sense of humor held together with a steely backbone that supports a sentimental heart. She's over talking about her kids with Brian Perry from Texas.

There's Sal Dragotta from Milwaukee, one of the most modest men I've met and also one of the most diligent. You might admire his business acumen combined with his friendly chides, but I admire the simple, adoring way he's looking at his wife. That speaks more to me.

At the end of the picnic table is Cathy Sutter out of Phoenix, the natural center of the conversation between Fred Goodwin and Rhett Grotzinger. She sports the latest from Niemans and holds herself comfortably aloft, while whispering a comment that would make a long-shoreman blush.

Walter Gallingshouse is talking to Harold O'Dell about what's up in Louisiana. Both are keeping their cards close, but they still have time to lend each other a hand when the need arises. Their conversation isn't loud, but Eddie Kneupper from San Antonio is drawn across the lawn by Walter's warm laughter.

With a smile that always shines in her eyes, Lori Barnes of Bakersfield, CA, quietly listens to her dad, George Gillam, near the ice cream freezer. The sense of family bond is tangible and gratifying to both. It meets the approving gaze of Dave Balsick from Colorado, who's kibitzing near the grill.

Lonnie Danchik, in from Dallas, is near the elm, telling tall tales to Bob Fetterman from Pennsylvania.

Ann Tripp is there from Peoria, IL, standing tall with her jaw out and a half-smile across her face that suggests she isn't just listening to Rick Joyce from DC. Ann's quietly sizing him up before she takes another delicate bite of potato salad.

Reg Swan from Cape Girardeau, MO, is permanently rooted in a



Illustration by John Hayes

people with a common interest, brought together by caring, sharing and dreams of a better tomorrow. It makes me think of the bigger table to which we draw up everyday across this country and of the people we have invited to share our dreams. In my mind's eye, this ideal picnic is filled with familiar faces from our industry.

For instance, there's Peggy Cook from Fresno, CA, a beautiful woman

Schwaninger, MRT's regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

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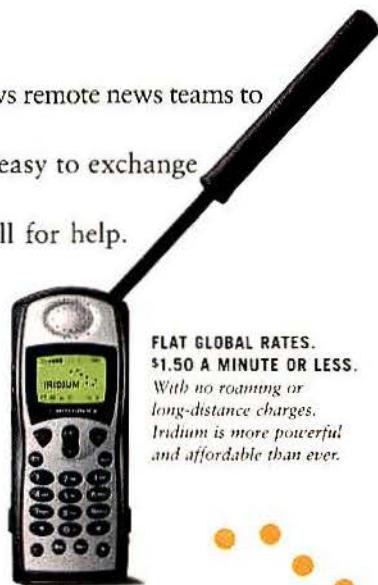
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CIRCLE (9) ON FAST FACT CARD

chair near the pool, sitting between his lovely wife and Steve Bandt from Janesville, WI, and wondering how he can get another beer without getting up.

Lou from Knoxville and Duncan from upstate New York are over pitching shoes. They're beating the hell out of Dave from North Dakota

and Joyce from Kansas.

They're all there at my imaginary table, celebrating our nation's birth with me.

There's Jeff Sohn, Mike Eisenbrandt and Arlen Dykema. Chris Salgot and Sam Klein and Ed Whisler and the always flirtatious Anna Garcia, who thinks she

can make Gordon Ichikawa blush. (She won't.)

John Komoroski from Raleigh, NC, is there with his wife. John hovers proudly around her, talking business with Maggie Suker from Vermont. Maggie is a no-bull dame whose charm is only outmatched by her blunt assessment of a situation. She suffers neither shyness nor fools.

Ed Sumpf is saying something to Mercy Contreras as they pass a private joke over near the garden. Something about Mercy in the garden makes me think of elves. Jack Mitchell watches them both, but he's thinking about something else, in his eye-aimed way, so hard that you can almost hear his thoughts.

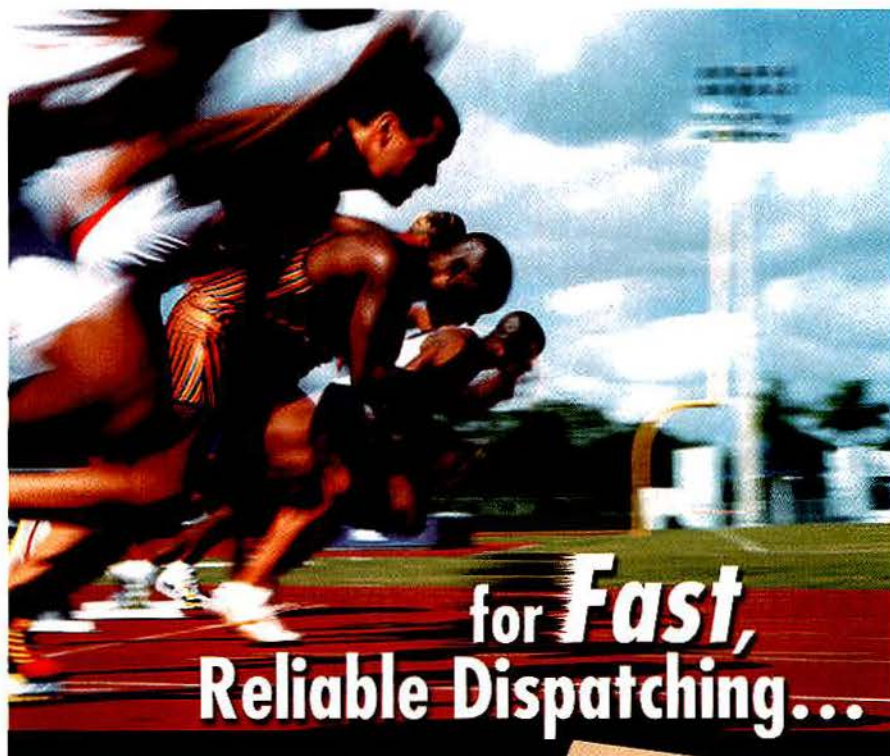
Jim Fryer is over swappin' tales and swiggin' beer with K.C. Wright, but both of them are playing to the smile on Mary Carlisle's face. Ron and Pat Brasher look on with quiet amusement, occasionally touching hands that have held together a marriage for so many years.

We the people

My guests believe in what they do and who they are. Each is convinced that hard work is more important than the hard sell. Each one enjoys a hymn and a firecracker and a whoppin' big parade that celebrates people—just plain people, not senators or financial titans—just the power and dignity of people.

"We the people" is, after all, about dignity. Not the kind of dignity that requires black ties or big titles, but the kind of dignity that comes from working hard. The alternative is being a sneak, and that alternative is not a choice we'd ever make. We take family, church, citizenship and fun seriously. We do not take ourselves too seriously.

We all know the Pledge of Allegiance and the *Star Spangled Banner*, not only as words, but as symbols of dreams fulfilled and sacrifices to be made. To each of the individuals who make up the chorus of voices that fill our industry, I thank you. You understand that it takes "We the People" to form a more perfect union. ■



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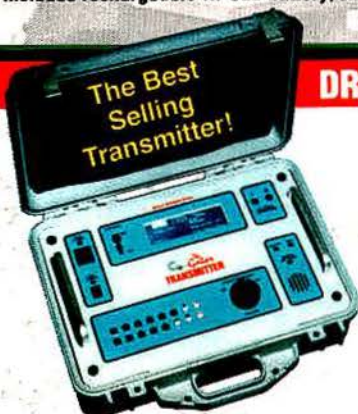
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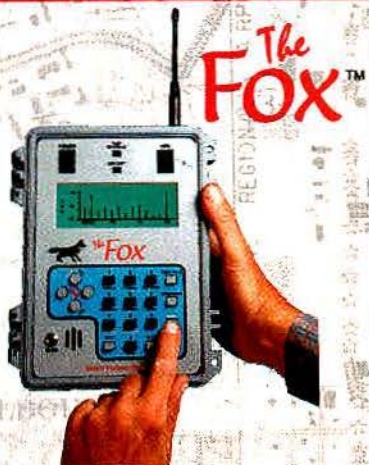
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CIRCLE (11) ON FAST FACT CARD



'Was that 336 calling for help?'

'Was that even 336?'

By David O. Dunford

Within the small group of dispatchers at the Lenexa, KS, 9-1-1 center, everyone gets a name.

When she started working for the department about 12 years ago, Debbie had attractively cut short hair, which she wore combed straight back. To a TV viewer of the 60s and 70s she was a ringer for Eddie Munster, hence the name: Eddie (Edward for more formal occasions.)

Eddie was working the weekend evening shift with Joe ("Stinky") and Jennifer ("Annie," as in Little Orphan), and there was substantial confusion on the street. Officers were using each others' radio numbers, and overlapping incidents on the interstate were making radio traffic difficult to understand. Dispatcher responses were slowed, and units were asked to repeat.

"Why can't we have some sort of speech recognition system, so we can tell what these guys are saying?" was the general complaint.

That's a good question, I thought. The problem in this particular case was the wind and highway noise on the interstate. Regular portable radio speaker-microphones seem extra-sensitive to wind noise, which is how high-ambient noise sources seem to manifest themselves. We've tried the noise-canceling microphones with minimal success. They are usually physically large, and unless the talker holds them close to

the mouth, the message is lost.

Fortunately, Lenexa is embarking on a scheduled radio system improvement project. As with any decent government capital project, this one has been in the financing and funding pipeline for five years. Curiously, the "plan" itself hasn't been modified much since its inception back in 1997. Our main goal was and has remained surprisingly simple: provide high-quality, reliable voice communications. Anything else would be gravy. Our new plan expands our conventional UHF radio system and incorporates technology features, such as simulcast transmission with operational features, such as ANI or unit ID.

Given current economic conditions, system price has become a more significant consideration for our small town. To multiply the effectiveness of our project, we've spoken with neighboring municipalities. Both operate conventional UHF systems and are interested in a joint-venture project whereby all three cities can share tower sites, facilities and operating frequencies. For a fraction of the cost of constructing a new, high-tech system, we believe that we can all enjoy substantial benefits of this joint participation.

But how is all this municipal fellowship and technical goodness going to help out the dispatchers, which is where the "rubber meets the road?" With the embedded signaling included with many newer conventional radios, we intend to incorporate basic ANI features (signal on deck) specifically to overcome that basic question. "Who was that calling?" If they don't recognize the voice or can't identify the radio number, at least there will be a visual display for dispatchers to read on the console screen. ■

Dunford, MRT's public safety consultant, is technical services consultant for the Lenexa, KS, Police Department. He is a member of the Association of Public-Safety Communications Officials-International. You can email Dunford at mrt@intertec.com.



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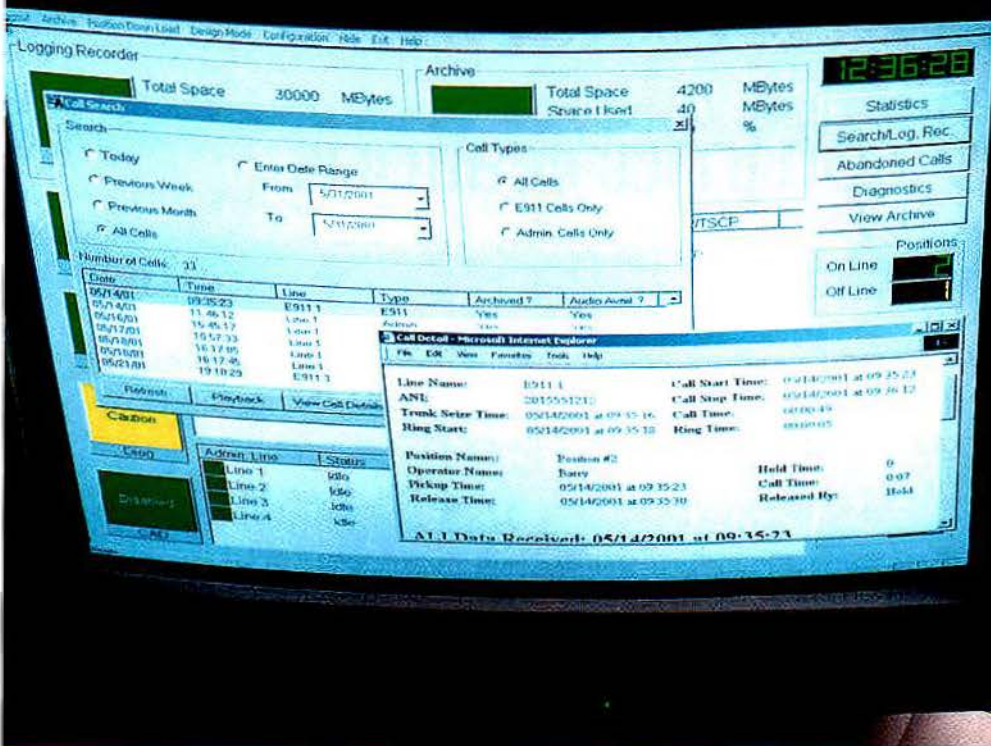
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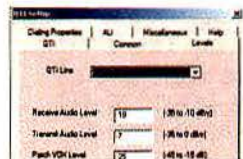
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Ottawa's communications consommé

Boiling down the stock of nearly two dozen radio systems to make one uniform broth isn't easy. The rebirth of the Canadian capital as a new municipality brings a host of public safety radio integration and interoperability challenges.

By James Careless

How do you make 22 radio systems become one? That's the challenge that the newly amalgamated city of Ottawa, Canada, has taken on.

Although old Ottawa is ap-

proaching its sesquicentennial and it has been the Canadian capital since 1867, Ottawa became a "new" city this year. For several years, the Ontario provincial government has been requiring mergers to consolidate local governments and to

reduce municipal transfer payments. Toronto, for example, was amalgamated in 1998.

On Jan. 1, 2001, the 11 municipalities that made up the former region of Ottawa-Carleton were compelled by the Ontario government to form a new municipality. Since being reconstituted, the new city's administration has been trying to integrate a mixed bag of public safety networks.

"The problem is that each of the municipalities that joined the new city had one radio network each," said Steve Kanellakos, general manager of Ottawa's emergency and protective services. "In some cases, they had more than one."

A further complication was that each municipality had gone its own way when it came to choosing equipment.

For instance, "The problem with fire is that you had some people using VHF and others using UHF," said Garry Rolston of

the consulting firm Lapp-Hancock. The Ottawa Transition Board, the provincial agency charged with creating the amalgamated city, hired Lapp-Hancock to recommend ways to integrate the new city's networks.

"As well, many of the smaller

towns and villages were using legacy systems; some of which are 20 years old—and older—and thus clearly out of date," Rolston said.

Public safety requirements for the new Ottawa are crucial. The city has a fast-growing urban economy, with an annual growth rate of 3% to 4%. Ottawa is now Canada's third largest municipality, with 785,000 residents, and Ontario's second largest city in terms of geographic area, covering 2,757 square kilometers.

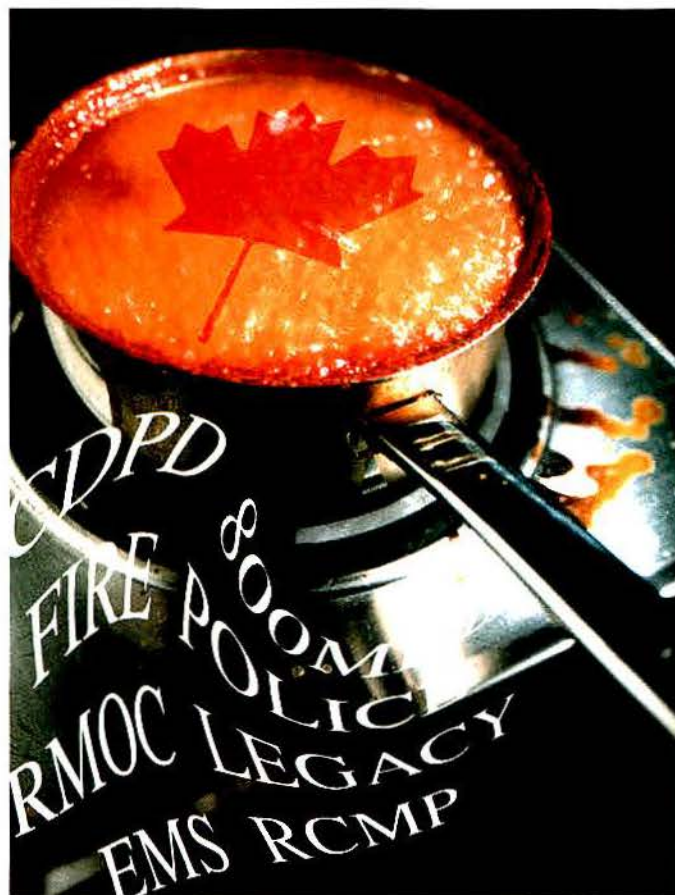
Integration: an obvious solution

All of the old radio systems that existed before amalgamation are still in place right now. From a practical standpoint, this means that "snow plows on one side of the street can't talk to those on the other side," said Kanellakos. The same can be said of Ottawa's other public works vehicles, and the fire department, too. In fact, the only services not cursed with incompatibility are emergency medical services and the Ottawa Police.

Ottawa EMS isn't affected because even though it is a municipal agency, the province runs EMS' Mobility's CDPD cellular service.

The Ottawa Police isn't affected because it already amalgamated a few years ago. When it did, it addressed the integration headache by installing an Ericsson 800MHz trunked network.

This network covers what used to be known as the "Regional



proaching its sesquicentennial and it has been the Canadian capital since 1867, Ottawa became a "new" city this year. For several years, the Ontario provincial government has been requiring mergers to consolidate local governments and to



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SS-30M*	25	30	3 1/4 x 7 x 9 1/2	5.0

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SRM-12	10	12	3 1/2 x 19 x 9 1/2	4.7
SRM-18	15	18	3 1/2 x 19 x 9 1/2	5.0
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

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SS-10MG, SS-12MG
SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
SS-10V, SS-12V, SS-18V

Municipality of Ottawa-Carleton" or RMO. An extra layer of government between the provincial and the municipal, the RMO shared responsibilities with the area's cities and towns. It ceased to exist when the new city was created. However, as luck would have it, the new city adopted the boundaries of

the old RMO.

As a result, when amalgamation took place on Jan. 1, the Ottawa Police wasn't affected. Neither was the Royal Canadian Mounted Police, which shares some spectrum on the police network. (The RCMP also has its own network.)

The situation begs the obvious

question: If the 800MHz network can serve the Ottawa Police, then why can't it serve all of the city's other integrated services? On the face of things, that seems to be the obvious solution, Rolston said. "The police have a very extensive 17-site network," he said. "Adding channels is quite possible, since the Ericsson system has rather large capabilities."

Steve Kanellakos is enthusiastic, to say the least, about this solution. "Having everyone on one network would be fantastic, especially during large-scale emergencies like the ice storm a few years ago," he said. "Right now, when police, fire and EMS are on the scene, they can't talk to each other; at least not without a lot of effort."

Guns are easy; hoses are hard

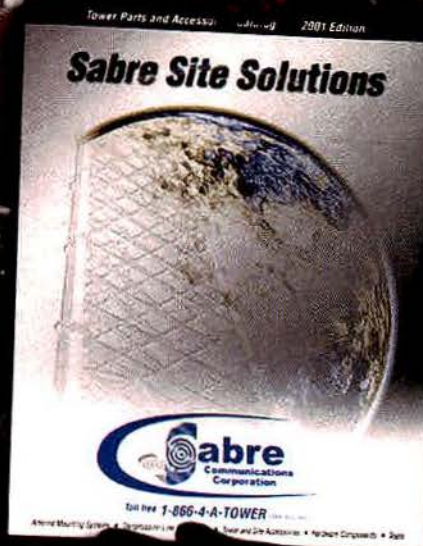
So why not just give everyone 800MHz radios and be done with it? Well, the problem is not that simple, Rolston said. The sticking point is the Ottawa Fire Department. Unlike the police, the fire department needs radios that work well indoors; not just in houses, but inside offices, malls and parking garages. So, can the 800MHz system do the job?

"Well, this idea has been investigated in other places," replied Rolston. "For instance, in Vancouver, the ambulance service was ecstatic when it was added to the police 800MHz network—the coverage was exceptional. However, the same can't be said for Vancouver Fire & Rescue. When they moved onto the network, Fire & Rescue ran into major problems in downtown Vancouver. There were places where their radio signals just couldn't get out."

Extending the network's reach

Vancouver Fire & Rescue's experience does serve as the source for a possible solution: vehicular repeaters. The agency installed the small retransmitters on their trucks to boost the signals going to the firefighters' radios, thus keeping them in touch with the network at all times.

The Search is Over

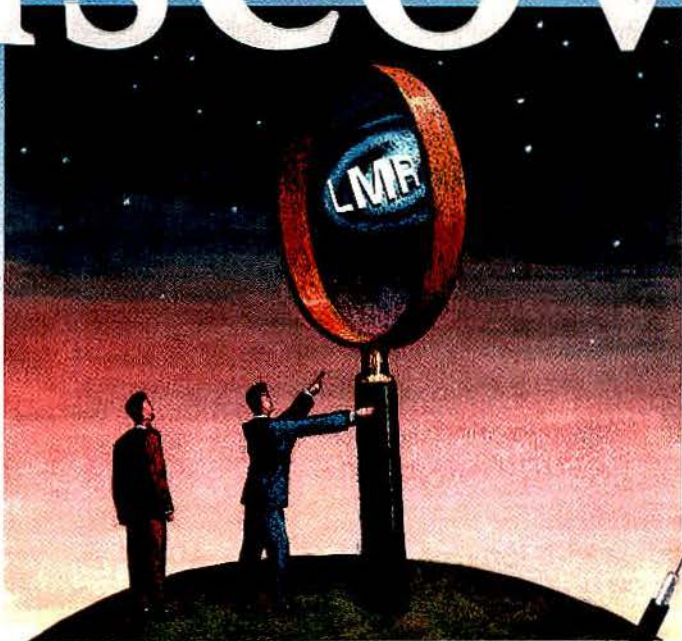


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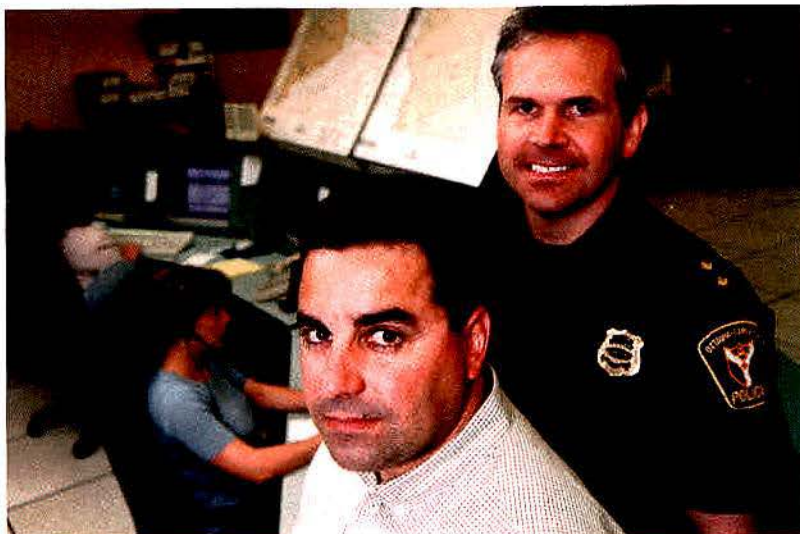
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Steve Kannellakos, general manager of Emergency and Protective Services and Inspector Charles Bordeleau, Communications Center office in charge of 9-1-1.

Another answer is bidirectional repeaters. Already mounted in the tunnels of Ottawa's sewage treat-

ment plant, a repeater system boosts retransmit signals traveling in either direction.

According to Rolston, both options could potentially work for Ottawa's fire department. To determine the feasibility of the solutions, Ottawa's Emergency Measures Committee is about to spend (U.S.)\$2 million to study whether the city's 800MHz network can serve everyone. Once the study concludes, the next stage will be to spend a budgeted (U.S.)\$4 million to buy new equipment, said Harold Murphy, the Ottawa city manager of emergency services.

Originally, this money was supposed to come from the now-defunct Ottawa Transition Board. However, a clerical error in preparing the new city's budget led to this expenditure being overlooked. No matter, Murphy said: "We'll either get the necessary funding from the city in next year's capital budget, or they'll find a way to squeeze it out of

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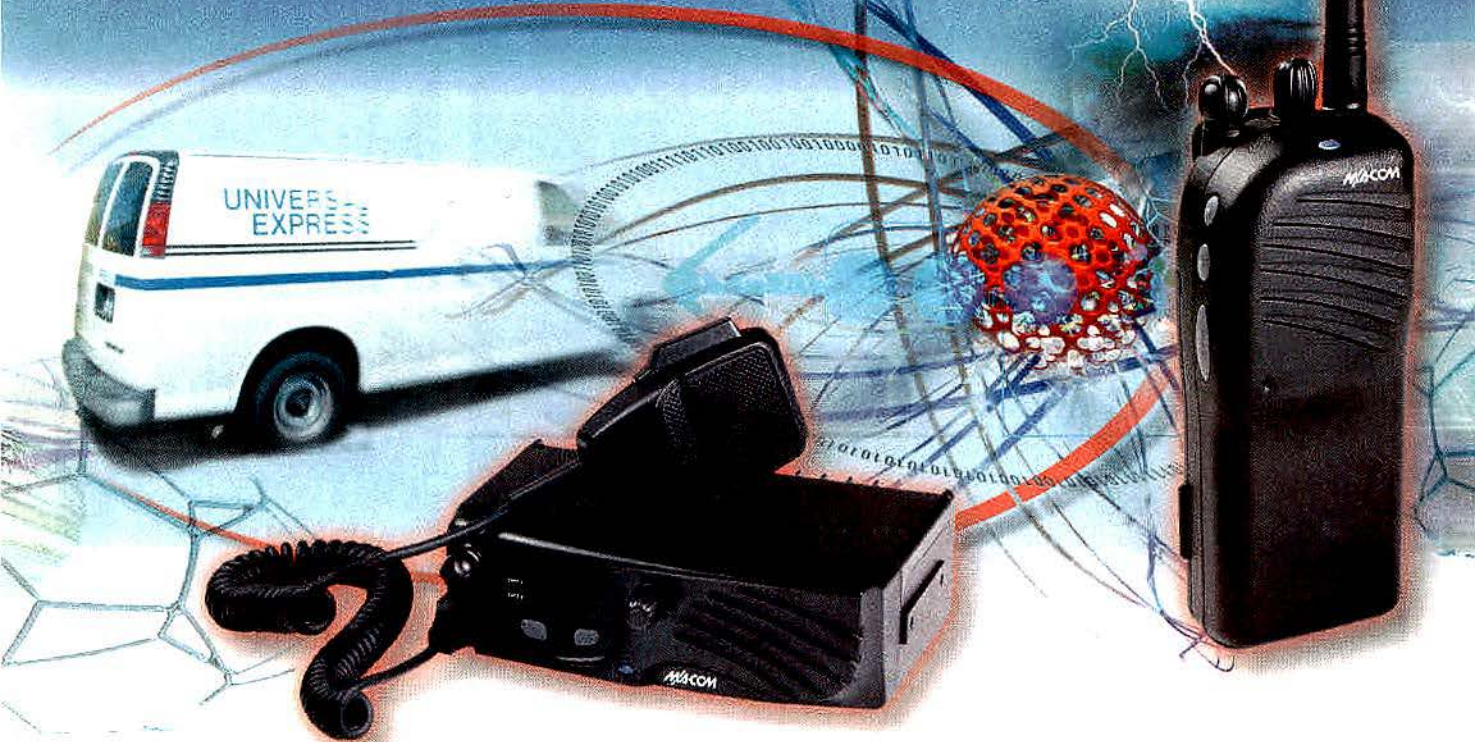
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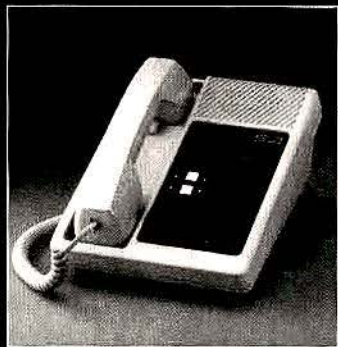
Further alternatives

What if it is determined that 800MHz is not a viable solution? This question, lurking behind Ottawa's network amalgamation, is not being raised much right now, as city staff hope for a straightforward solution to this problem. However, if 800MHz isn't practicable, it could be possible to employ a two-frequency approach: one that uses 800MHz to link fire trucks to the city's other services and a second bandwidth to link firefighters to their vehicles.

Another approach would be to put fire on another frequency altogether. However, this would perpetuate the current isolation that Ottawa hopes to end through amalgamation. Therefore, even if a separate-channel approach costs less, chances are that the city will not adopt it willingly.

In the meantime, Ottawa's 22 networks are being bound together at one public answering point, by a single telephone number. "By calling 580-2400, people can access all city services from one point except for emergency services, which are still at 9-1-1," Kanellakos said. "We may be aware that we're running through a patchwork of networks, but at least they're not." ■

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CIRCLE (20) ON FAST FACT CARD

Radio control line instrumentation, measurements

By Harold Kinley

Remember the good old days when remote base stations were controlled with dc over *metallic* lines? Metallic lines were simply lines that would provide dc continuity from end to end, allowing a dc current to pass through the ra-

dio control loop. It was a problem keeping the control current at the correct level to perform the various control functions.

Changing the routing of the control line, something that a telco always seemed to find delight in doing (they called it re-engineering), would change the loop resistance and therefore the control current.

Later, dc remotes were designed with current-regulated supplies—which greatly reduced the problem of improper current levels for the control relays. However, telcos also seemed to delight in reversing the polarity of the control pair. This reverse happened so frequently that we installed polarity-reversing switches on our equipment so that correcting the reversed wiring came down to simply flipping the switch.

After a while, metallic lines went by the wayside. Telcos could no longer guarantee that we would have dc continuity from end to end. Then came tone remote systems. Better, right? Well, not always. Now, instead of different current levels for control functions, different tone frequencies are used for various control functions. For example, to key the transmitter, a tone frequency of 2,175Hz is sent down the line to the tone termination panel. A special notch filter circuit is used to remove the 2,175Hz tone so that it is not passed on to the transmitter exciter.

Units of measure

Certain units of measure are encountered with line testing and associated equipment.

dBm—This is an absolute unit of measure based on 1mW in a 600Ω impedance. Thus, 0dBm refers to a signal level of 1mW in a 600Ω impedance. This is equivalent to 775mV across 600Ω. Using the formula for power:

$$P = \frac{E^2}{R}$$

We can rearrange that to yield:

$$E = \sqrt{PR}$$

Substituting, we have:

$$E = \sqrt{0.001 \times 600} = \sqrt{0.6} = 0.77459$$

This is usually rounded off to 0.775V or 775mV.

Voltage across 600Ω can be converted to dBm thus:

$$dBm = 20 \log \left[\frac{E}{0.775} \right]$$

and dBm in 600Ω can be converted to voltage by the formula:

$$E = 0.775 \text{ anti log } \left[\frac{dBm}{20} \right] \text{ or}$$

$$E = 0.775 \left[10^{\frac{dBm}{20}} \right]$$

dBm—This is generally used to refer to line noise level. 0dBm equals -90dBm, which is equivalent to 1 picowatt in 600Ω. To convert dBm to dBm, simply subtract 90dB from the dBm level to get the equivalent dBm level. For example, 10dBm = 10 - 90, or -80dBm.

C-message filter—This type of filter is often used in voice circuits. The filter response covers the frequencies used for voice communications. Any noise or interference at frequencies lying outside this band are not detrimental to voice communications.

Three-point slope test—Normally, in telephone-line work, test frequencies are offset by 4Hz. For example, 1,004Hz is used instead of 1,000Hz. Other test frequencies are 404Hz and 2,804Hz. For the three-point slope test, the level at 1,004Hz is taken as the reference and the level at the other two frequencies is given as the slope as referenced to the 1,004Hz level. For example, if the level at 1,004Hz is measured at -5dBm, the level at



Photo 1: The Helper Instruments Lineman test set is being checked and calibrated by the Convex Model 806A TIMS. The output level of the Lineman is set to 0dBm at a frequency of 1,004Hz. As seen on the Model 806A, the output level is correct but the frequency is in error by a few hertz.



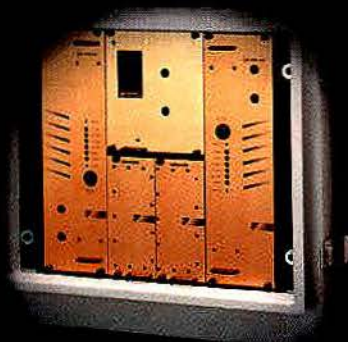
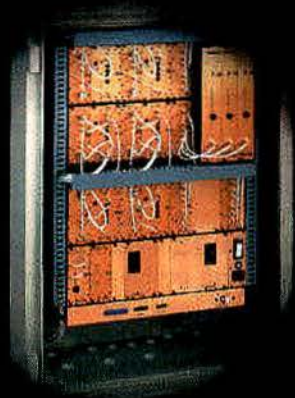
Photo 2: The Model 806A is set to the bridge mode to read the noise level on the line with the normal equipment connected to the line. As seen here, the noise level is 21.9dBm. This is the equivalent of -68.1dBm. The noise is read through a C-message filter. Any noise or interference outside the passband of the C-message filter is considered non-detrimental to communications.

Contributing editor Kinley, MRT's technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyde Drive, Spartanburg, SC 29301. His email address is hkinley@home.com.

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404Hz at -10dBm and the level at 2,804Hz at -14dBm, the slope at 404Hz is -5dB and the slope at 2,804Hz is -9dB.

Testing remote control lines

You should be equipped to do

some testing of the remote control lines yourself, and testing should be done before reporting any problems to the telco. Otherwise, if the problem is not with the telco lines, you might be charged for the time it spends in checking the line.

Testing the line from end to end will require two technicians, one for each end, with necessary test equipment. The following discussion is for a typical two-wire voice frequency base station *tone remote* control line. All this line needs to do is to pass the audio frequencies from 300Hz to 3,000Hz without severe attenuation.

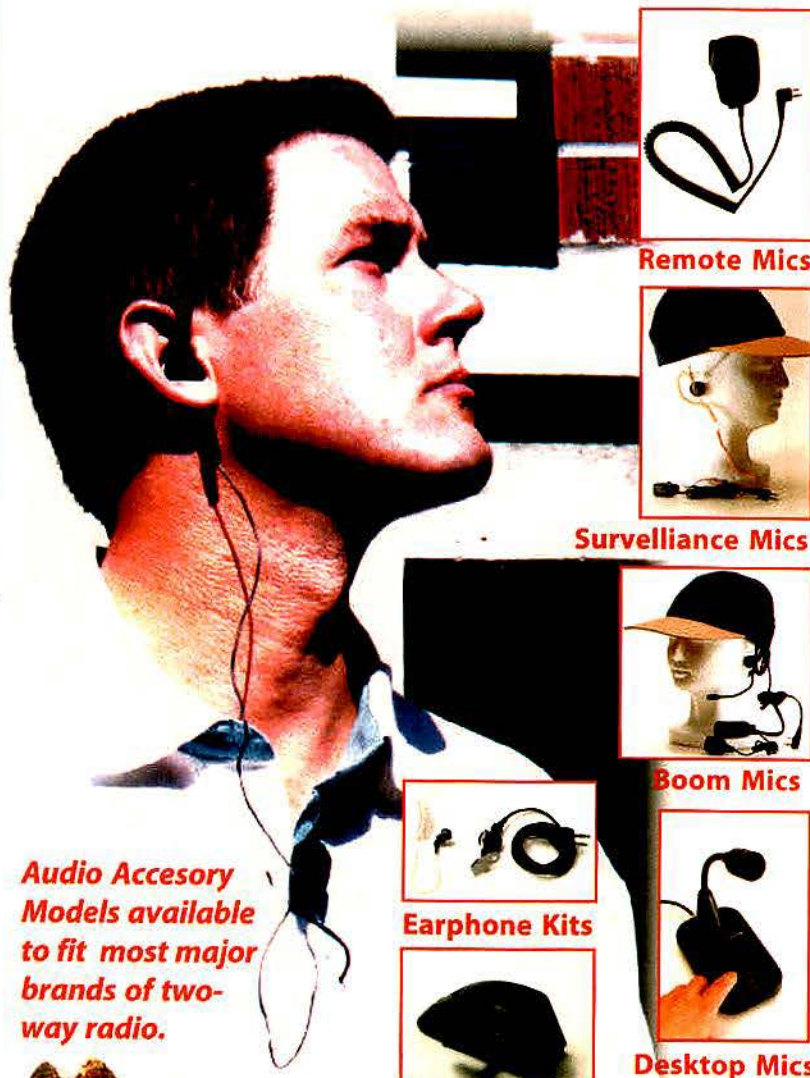
Photo 1 on page 22 shows different test instruments that can be used for troubleshooting remote-control line problems. The small box (Helper Instruments Lineman) shown on top is the one we normally use for basic line testing. It is simple, small and easy to use. The larger box shown at the bottom is the Model 806A Transmission Impairment Measurement Set from Convex (Simulcast Solutions). On the World Wide Web see www.simulcastsolutions.com and visit www.convexcorp.com/PRO_LIST.html. For a good tutorial on using the Model 806 for simulcast work, go to the bottom of the Web page and click on "simul 01.pdf."

One recent remote control line problem we experienced took the telco five days to clear. Dealing with the telco on such line problems has been one of the greatest sources of frustrations I have experienced on this job. The telco never seems to "get it."

As it turned out, my associate was first dispatched to the remote site to check out the problem. He found dc on the line from the telco battery. It was not supposed to be there. He tried to explain to the telco technician that our equipment doesn't need battery voltage to operate. An entire day was wasted while the telco goofed around with the problem.

To make a long story short, two more days were wasted while I sat on the mountaintop waiting on the telco. This has been a typical experience. The telco likes to do line testing from some remote spot with automated test equipment and then tell you there is *no problem* with the line. (Never mind the fact that you can't get a tone from one

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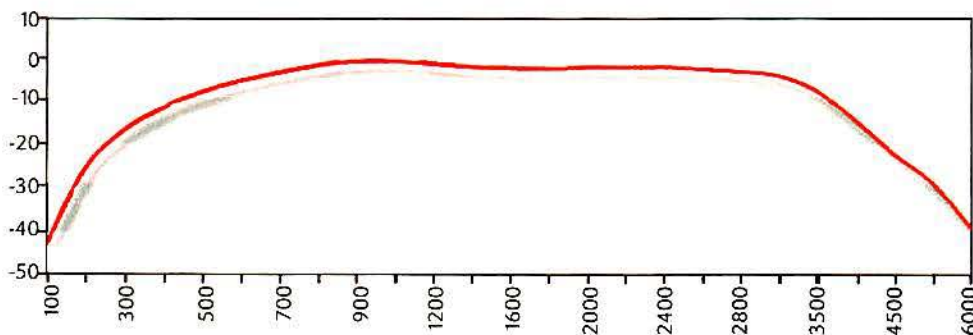


Figure 1. Response of C-message filter of the Model 806 TIMS as measured at the frequencies shown on the X-axis.



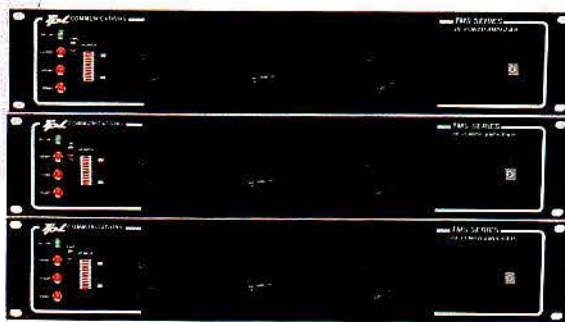
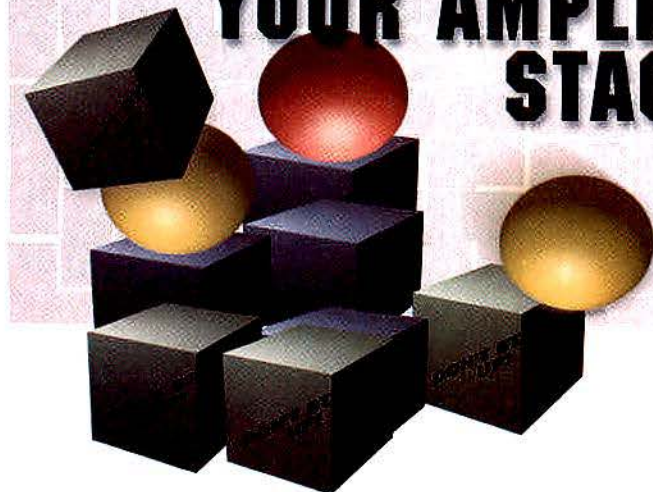
Photo 3: The Model 806A is set for the same noise measurement as shown in Photo 2, except the noise is measured in dBm instead of dBm. The dBm reading is -68.2dBm.

end to the other.) If you try getting two of the telco's techs together to do end-to-end line tests, good luck.

In most cases, I like to do a complete line-response test after a line has been repaired to establish a new benchmark for future reference. Generally, the test involves setting the tone level to 0dBm at

the sending end and measuring the level at the other end. The beginning reference frequency is 1,004Hz. The control line is isolated from everything except the test equipment on each end. The measuring instrument on the receiving end is placed in the "terminate" position. This places the proper 600Ω termination impedance on the control line. The level of the 1,004Hz tone is measured and recorded. If it measures -10dBm, then the line loss at 1,004Hz is 10dB. Similarly, the line loss is measured at other frequencies (404Hz, 2,804Hz and all the tone control frequencies), especially the transmitter keying frequency of 2,175Hz. Strange notches in the frequency response can occur, and if one of these notches falls on a control frequency, you might lose one of the control

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Photo 4: The Model 806A is set to measure the S/N ratio of the signal from an audio generator. As shown, the S/N ratio is greater than 50dB. The measurement is made at a frequency of 1,004Hz or within a few hertz of this frequency. This is the center of the notch filter in the instrument. Anything greater than 50dB will be indicated by the HI at the left of the number on the display.

functions. The test is performed in both directions, reversing the sending and receiving ends, because the response can be different with non-

metallic lines.

The Lineman from Helper Instruments (now owned by Zetron) provides many of the control tone frequencies at the flip of a switch, including the keying tone (guard tone) of 2,175Hz. This switch makes it simple to measure the line response at key frequencies. An intercom feature allows communication between techs at each end to coordinate the tests.

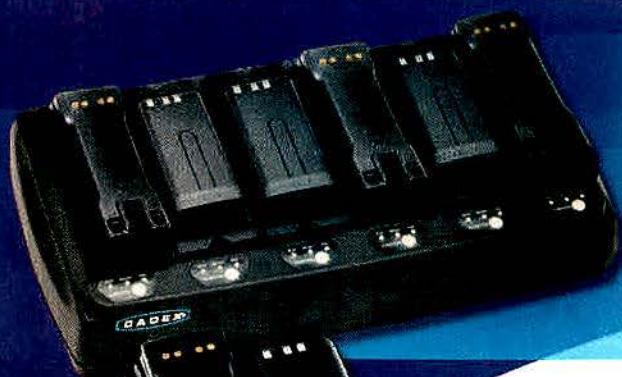
The Model 806 TIMS from Simulcast Solutions is an excellent instrument. However, for most types of line testing work with which we are involved, it is overkill. The types of tests for which we used the Model 806 were much simpler than the maximum capabilities of the instrument. In photo 2 on page 22, the Model 806 is placed in the bridge mode and connected across a remote-control line. It is

set to measure noise through a C-message filter. A graph of the C-message filter response of the Model 806 is shown in Figure 1 on page 26. The passband of the C-message filter is considered the "meat" of the voice frequencies for communications purposes. Photo 2 shows that the residual noise level measured on the control line with a Model 1806 TIMS is 21.9dBrn. Remember, 0dBrn equals -90dBm. Therefore, 21.9dBrn equals $21.9 - 90 = -68.1\text{dBm}$. In Photo 3 on page 26 the measurement unit is switched from dBrn to dBm and reads -68.2dBm. You might encounter the term *dBrnc*. The *c* indicates that the noise is measured through a C-message filter.

Photo 4 at the left shows the Model 806 TIMS measuring the audio tone from an audio-function generator. As shown at the left in

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Photo 5: The Model 806A shows that the S/N ratio measured at 940Hz is at about 10dB. This is because the audio test frequency is not properly notched out because it lies outside the notch frequency of the instrument's notch filter.

the photo, the input is set to terminate the line in a 600Ω impedance. First, the output level from the function generator is set to 0dBm and then the frequency is set to 1,002Hz. Another nice feature of the Model 806 is it indicates the frequency of the tone being applied to the instrument. The C-message filter is switched in and the Model 806 is set to measure S/N ratio.

As indicated on the display, the S/N ratio of the tone applied to the instrument is greater than 50dB. The instrument is designed to measure S/N at a tone frequency of 1,004Hz. This is the normal reference frequency used in line work. If the tone frequency is moved up or down from 1,004Hz, the notch filter in the instrument will not completely remove the tone, and it will be measured as noise or distortion. Photo 5 above shows that a tone at 940Hz will have a S/N ratio of about 10dB.

Distortion in percent can be converted to S/N by the formula:

$$S/N = 20 \log \left(\frac{100}{D} \right)$$

For more information on the Convex Model 806 TIMS check out the Web sites listed earlier or contact:

- Email: Turner_J@convexcorp.com, Convex, 45150 Business Court, Sterling, VA 20166, Tel: 703-318-8991, Fax: 703-318-8994.
- Ed O'Connor at ed@simulcast.com, Simulcast Solutions, 18 Port Meadow Trail, Fairport, NY 14450, 716-223-4927 Fax: 716-223-3255.

where D is distortion in percent.

The percentage of distortion can be calculated from S/N by the formula:

$$D = \frac{100}{10^{\frac{S/N}{20}}} \text{ or } \frac{100}{\text{anti log} \left(\frac{S/N}{20} \right)}$$

Photo 6 at the right shows the measurement of noise

with tone. The noise level is shown to be -39.4dBm. If the tone level is at 0dBm, then the S/N will be 39.4dB. Photo 7 at the right shows the same measurement but in units of dBrn. Note that -39.4dBm is the equivalent of 50.6dBrn ($90 - 39.4 = 50.6$).

The Convex Model 806 TIMS will do so much more than was needed in our situation. The unit also features an automatic sweep function to do a swept frequency response of the line. The instrument can also test digital lines. More features are available if the unit is linked to a computer serial port. On the down side, no intercom feature



Photo 6: The Model 806A is used to measure the noise with tone. If the tone is at a level of 0dBm and the noise is at -39.4dBm, then the S/N ratio is 39.4dBm.



Photo 7: The Model 806A is set to measure noise with tone in dBrn units. The equivalent of -39.4dBm is -50.6dBrn as shown on the display.

is provided to help the tech communicate from opposite ends of the line. The red LEDs are also difficult to read in bright light.

Overall, the Convex Model 806 TIMS is an impressive instrument, capable of doing much more than we attempted. (We barely scratched the surface.) The basic unit sells for about \$2,500. Options are available at extra cost.

Until next time...stay tuned! ■







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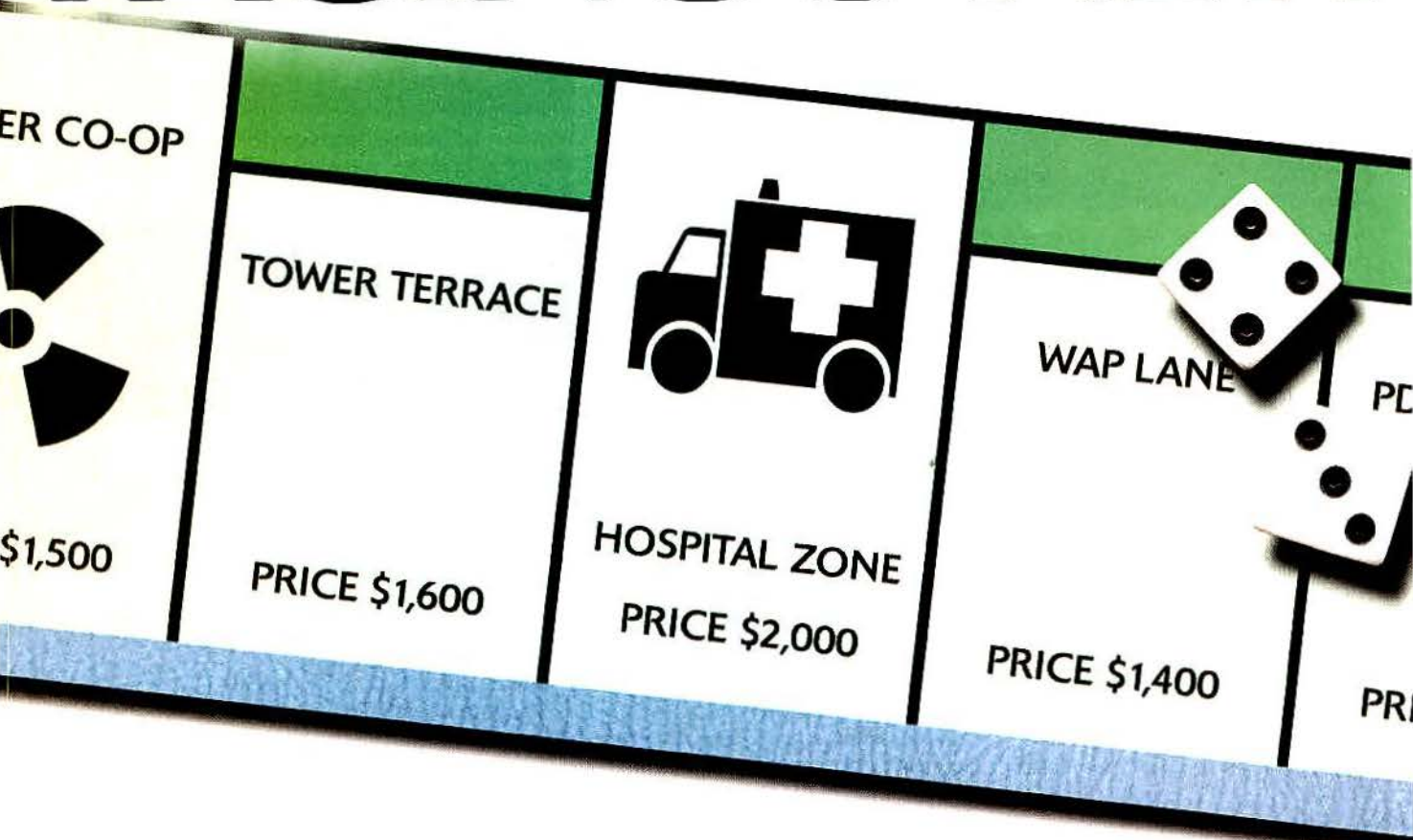
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PAGING'S NEW



Take the bad news about large paging equipment manufacturers and carriers from the board, and you will find thriving players, including customer-owned systems and small carriers.

This year's changes in the paging industry could take your breath away.

Glenayre exited the paging infrastructure business, halting sales of transmitters and terminals. It reduced its employee count from 1,300 to 500 and relocated its headquarters to Atlanta, where it focuses on manufacturing "unified communications" products.

Unified communications integrates subscriber services to merge message types from wireless instant messaging to multimedia to legacy pager notification and faxing. It allows carriers to bridge various networks and protocols, and to deliver

voice and data messages wherever and whenever subscribers want—to the home or office desktop, via the Internet, to a WAP phone, wireless PDA or virtually any other device.

Glenayre's stock, which once traded as high as \$66, fell to a price below \$1 during the past year.

WebLink Wireless, a Dallas-based paging carrier with a nationwide frequency and two million subscribers, filed for protection from creditors under Chapter 11 of the U.S. Bankruptcy Code on May 24 and said it planned to convert \$470 million in high-yield debt to equity. On July 20, the company, once known as Page-Mart, received court approval to

accept \$15 million of debtor-in-possession financing from two of its current principal lenders.

WebLink told the court it plans to seek a stand-alone transaction with new financing or a merger or sale transaction, on which the company expects to base a plan to emerge from Chapter 11. The company's stock, which sold for as much as \$26 in February 2000, fell to as low as 3 cents per share during the past year.

Arch Wireless, based in Westborough, MA, uses more than 250 offices and company stores to cover 93% of the U.S. population and to serve millions of customers with wireless email, instant text

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By Don Bishop

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messaging and mobile Internet access. The network uses Reflex 25 digital point-to-multipoint paging and boasts greater landmass and population coverage of cellular, PCS and wireless broadband combined.

Yet its customers are leaving fast. On July 23, a statement from the company said that it expected to report a decline of nearly one million one-way paging customers during the second quarter this year. This reversal trampled Arch's plans to convert debt to equity. The company's financial results and the lack of additional sources of liquidity indicate that it may not be able to continue as a going concern.

On Aug. 2, Arch said that one of its operating units had defaulted on a \$1.3 billion bank credit line, and another had defaulted on about \$350 million of senior notes. The company's stock, which traded as high as \$6.76 per share during the past year, had fallen to as low as 1 cent during the period.

Where, then, is the good news? It is with small paging systems and small infrastructure manufacturers.

Larry MacKnight, the product sales manager for Zetron Paging Systems, is a 16-year veteran of Zetron. He said the company's migration to its current form has taken years, but "we knew where we were

going." Zetron focuses on switching and telephony, as well as paging controllers and infrastructure.

MacKnight said Zetron's foremost business is public safety consoles, but paging infrastructure is a good business to be in "because paging is not dead. We believe that many people got sucked into the wrong technology for paging and spent too much money. Some got discouraged and went broke. Their business plans didn't come together and they abandoned it, ran out of money or their parent companies

Bishop is editorial director. His email address is dbishop@primediabusiness.com.



Cover Story

shut down their divisions." He said that Glenayre's exit from the paging infrastructure business is a two-edged sword.

"I enjoyed the Glenayre 'marketing and pricing umbrella,'" McKnight said. "The company never really disturbed Zetron's market that much. Glenayre sold high-end commercial systems where a lot of pagers were required and where PCS and other channels used by their customers

were saturated," he said.

Meanwhile, Zetron has been selling smaller paging terminals, particularly into the privately owned paging sector that includes hospitals, utility companies, universities and other entities that commercial service isn't suitable because carriers couldn't guarantee delivery quickly enough. Coverage has not been the problem. The problem has been the time required to process

a page within a commercial system: "sometimes 10 minutes to an hour. Many minutes, not a few minutes," MacKnight said.

"It's important for hospitals and nuclear plants to have their own paging systems. For those and other private users, it's the efficiency of the communications system that makes sense, not the fancier PCS devices. That's why I don't think paging will die for a long, long time.

"Another reason is because now that the larger paging companies are getting out of the business, the equipment providers for those larger carriers are having trouble and dropping right and left. This will spawn a new era of mom-and-pop and regional carriers. I've talked with regional carriers who have already been building in areas abandoned by larger carriers," MacKnight said.

'Right-sizing' for paging

"We're right for the size of the companies who are continuing to grow in the paging business. We don't have the mega-terminals. Ours serve as many as 40,000 to 50,000 pagers per terminal for coding and voice messaging, all the way down to small paging terminals, such as the discontinued Motorola People-Finder, a terminal with a built-in transmitter and a rubber-ducky antenna. We have a replacement unit for that," MacKnight said.

Randy Murray, president of Redi-Call Communications in Georgetown, DE, has had success in recent years supplying private systems to hospitals. He said the hospitals use as many as several hundred pagers. He added that many of the hospitals later converted to using his wide-area paging system for greater flexibility when hospital staff needed to travel beyond the confines of the hospital.

"Our biggest concern is that the whole paging industry will get a black eye because of what the large carriers are experiencing. We have a stable market. But news about the big companies has the potential to affect us," Murray said.

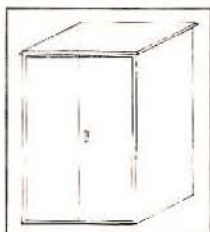
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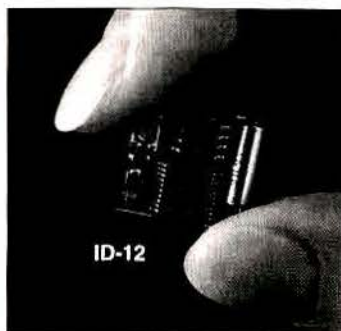
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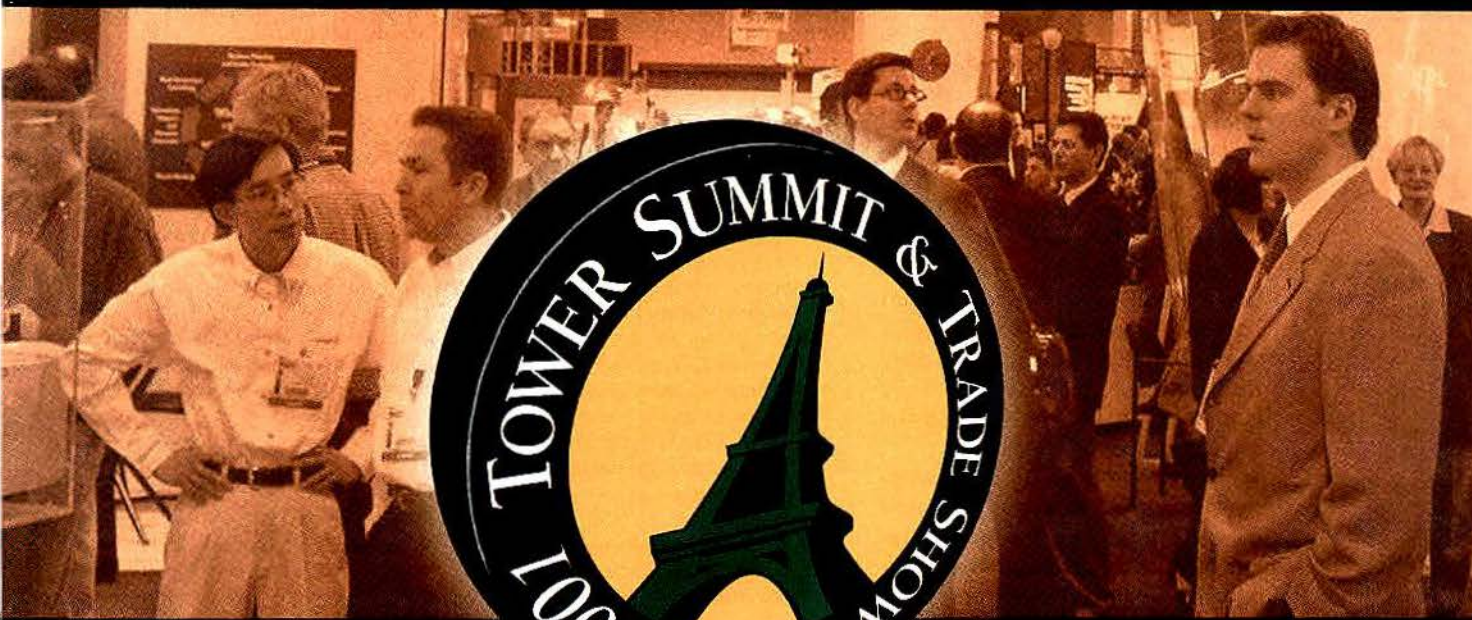
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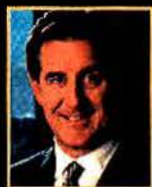


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to 25,000 paging customers and also operates a two-way radio communications dealership.

MacKnight said that his company provides controllers, terminals and the remote control infrastructure to extend the signal from the terminal to the transmitter, which normally are not collocated. Zetron does not provide transmitters, antennas or pagers. A list of terminal and transmitter manufacturers appears on *MRT's* Web site.

Where would someone go to engineer a new system?

Local resellers offer that assistance. MacKnight explained that Zetron's resellers, for example, should be able to help a company find a license, purchase ancillary equipment, install it and help the company learn how to run it.

"We have in-house technical support for after-sale support and training programs for our equipment, but we don't support an end-user in securing a license or installing transmitters."

MacKnight said that his message about the paging industry is that paging is a new opportunity, not one that is dying.

"Smaller regional commercial carriers are realizing an opportunity to build-out. The customer-owned paging industry is alive and

well, particularly in mission critical paging where it is not only a medium of choice, but one of necessity. It probably will be that way for years to come until something comes along with better coverage, range and timely delivery," MacKnight said. ■

Frequencies for sale

According to its latest schedule, the FCC will auction 15,000 paging frequencies on Oct. 30. There is still time to apply. Sept. 17 is the deadline for the short-form application. Details are available at www.fcc.gov/wtb/auctions.

Kathleen Kaercher, an attorney with the Washington law firm of Blooston, Mordkofsky, Dickens, Duffy & Prendergast, said that prices should be low enough to satisfy smaller paging system operators.

Some 15,000 licenses are up for sale, including licenses that weren't sold in previous auctions or that for various reasons were returned to the FCC.

"With 15,000 licenses, almost everyone ought to be able to find something in their market. Whether it's affordable or

not, that's up to each bidder. Any potential bidder should check to see who is already operating in their area of interest and make an informed decision regarding what price to offer," Kaercher said.

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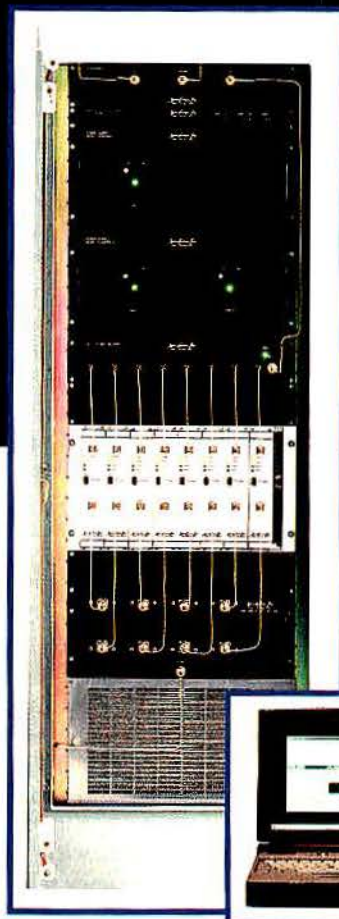
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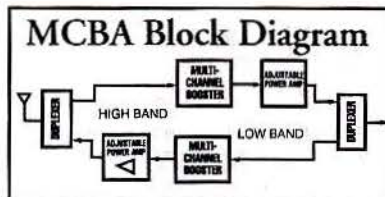
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CIRCLE (39) ON FAST FACT CARD

How's your antenna?

Part II—The halfwave antenna is expanded into many other configurations, each having specific contributions to how RF energy is sent or received.

By Patrick E. Buller

In the past, antennas were generally used for fixed, single-frequency operations. Today's needs require antennas to have a much broader bandwidth to cover more frequencies. These new requirements include repeaters with wide frequency separation or the combining of more than two transmitters into one antenna.

One approach to increased bandwidth is the incorporation of larger-

diameter material that lowers the antenna "Q" (discussed in Part I). Methods used to accomplish this incorporation include increasing conductor diameter or using more than one paralleled conductor. Parallel conductors define a circle that has the effect of a single conductor with a diameter equal to the spacing of the parallel conductors.

The bow tie antenna is another example of a large surface area that also increases bandwidth, often used in antennas for 450MHz and above. The folded conductor of a bow tie antenna also changes impedance.

Impedance change

In a classic, folded dipole antenna, as shown in Figure 1 at the left, there are parallel conductors, but only one conductor is fed power. It raises the impedance of the feed point by the relationship of quantity of conductors, squared, times the antenna impedance. For example, a pair of wires $(2)^2 = 4 \times 72\Omega = 288\Omega$.

A three-conductor antenna raises the impedance nine times, providing all conductors are the same diameter. If diameters are equal, then spacing between wires and conductors is not a factor. If the diameters of the conductors are not the same, the spacing is indeed important.

If, instead of feeding only one of the two conductors, both conductors of each leg are made common, as shown in Figure 2 at the left, then the bandwidth is the same as the folded dipole, but the impedance is close to the classic 72Ω . Why the impedance difference? The folded dipole shares the current equally between the parallel wires; therefore the current in each wire is half that of a single conductor.

The folded dipole has several features that make it useful as a vertical collinear antenna. Besides increased bandwidth, wind loading is somewhat increased, but vibration is drastically reduced, which eliminates metal fatigue that is common in single elements of ground-plane antennas. Noise caused by particles whizzing past during high winds is reduced, and the lack of sharp points eliminates *corona noise*. Corona noise is observed by hearing a high-pitched squeal sounding like a siren with ever-changing pitch. Corona noise stops immediately after a lightning strike.

Impedance changes when different diameter conductors are part of the feed. The final impedance is a function of the ratio of diameters of each element and the spacing between conductors.

When comparing the impedance of a center-fed dipole of 72Ω to that of a ground-plane antenna of 36Ω , consider the geometry. The dipole is two conductors in the same plane, and the vertical antenna has one vertical, the other horizontal. Moving the horizontal element from horizontal down to about 40° raises the impedance to around 50Ω , which is valid for a single-element vertical antenna with a modified ground plane as shown in Figure 3 at the left.

The collinear antenna

Collinear means having axes

Buller is a special projects engineer for Tacoma Power, Tacoma, WA. For many years he served as an electronics design engineer for the Washington State Patrol. He is a member of IEEE, NARTE, APCO and ARRL, and he is a Fellow of the Radio Club of America. His email address is W7rqt@msn.com.

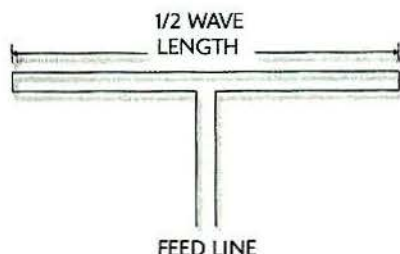


Figure 1. One halfwave antenna.

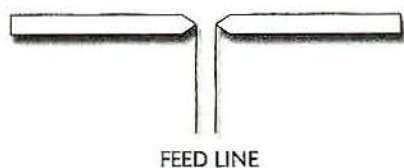


Figure 2. One halfwave antenna.

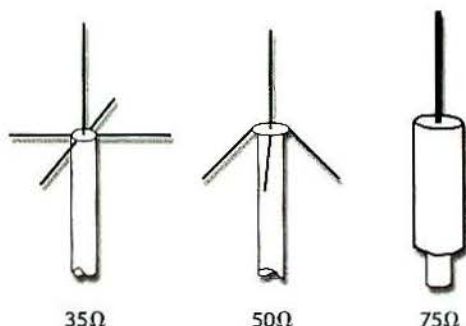


Figure 3. Impedance change by angle.

lying end to end in a straight line. Collinear antennas for the two-way radio market are usually made up in pairs. This is a gain of 3dB when one more element is added to a single element. For an additional 3dB, the two elements must be doubled, yielding four elements for a total antenna gain of 6dB.

The most common 6dBd vertical antenna for the 150MHz band consists of four halfwave rigid coax cable pieces fed at the bottom with an impedance-matching transformer enclosed in a fiberglass tube as shown in Figure 4 at the right. Note that the coax antenna elements have conductors changing positions between elements. All elements must have the same phase relationship for each element to contribute energy perpendicular to the elements. Therefore, it is necessary to have correct polarity. Remember that the phase changes 180° in halfwavelength. If the polarity were not changed, and elements were not transposed, the antenna would be two wavelengths long. No energy would radiate perpendicular to the elements, meaning no signal on the horizontal—just a four-leaf clover pattern with no radiation broadside or off the ends. In reality, the coax linear is not a true 6dBd but about 5.4dBd because of the uneven power distribution. The bottom element has to feed the other three, and the top element feeds none.

Another common antenna in the two-way industry is the folded dipole array. It is fed with equal lengths of coax cable, which allows energy to arrive at all antenna elements at the same time. Figure 5 at the right shows a cable arrangement that is not only acting as a phasing harness but is impedance matching as well. Quarterwave transmission lines will also perform as transformers. The advantage of this type of antenna, compared with the coax collinear, is each element is fed the same amount of power and its gain is near the full 6dBd. Arranging the elements around the vertical support can modify the radiation

pattern. This option is not available with the coax collinear antenna.

Downtilt

Collinear VHF antennas with a 12° beamwidth that are installed in high elevations do not cover nearby low elevations. In short, these antennas talk well mountaintop-to-mountaintop, but not down to the highway, where they are needed. Downtilt is when the beam is electrically lowered below the horizontal plane. This is done by a phase shift of power between each radiating element. This phase difference between elements forces the beam down from the horizontal.

Figure 6 on page 38 shows the phasing required for downtilt. Each element going in the vertical direction has leading phase from the lower element. The downtilt is limited to about 6°. Beyond this limit, side lobes appear that defeat the goal of downtilt and gain.

Phased arrays

A single antenna has a definite gain. Duplicating this antenna and feed from the same source will provide 3dB more gain. Duplicating again will add 3dB more. The collinear antenna is one example of *phased array*. In the classic *broadside phased array* as shown in Figure 7 on page 38, eight dipole antennas are connected to a transmission line. Note that the transmission line is transposed. To have the antenna appear as one large antenna, all elements need to be fed with the exact same phase. For example, assume all elements will have the left side instantaneously positive. Each antenna is spaced halfwave apart, therefore the transmission line is transposed because the energy is shifted 180° in the halfwave transmission line. The center transmission line, however, is not transposed because the energy being fed in the center arrives at each antenna at the same time. If the antenna array were fed from the bottom, the center phasing harness would have a transposition.

The key in any phased array is

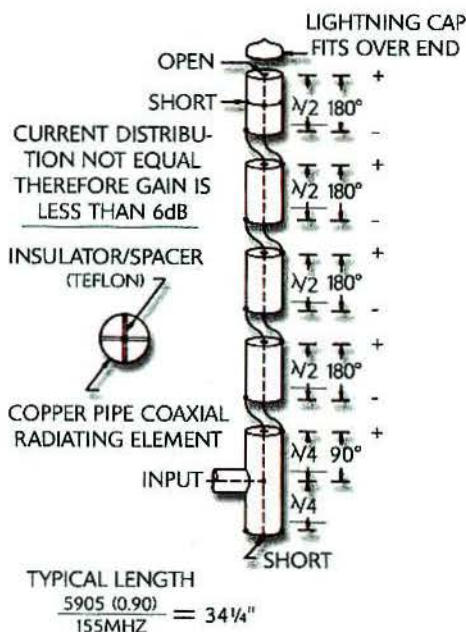


Figure 4. End fire collinear antenna.

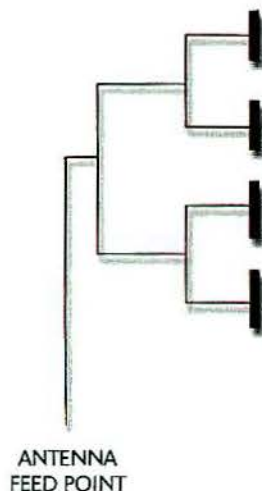


Figure 5. The collinear.

keeping all elements in the correct phase relationship. Antenna patterns can also be shaped by changing the spacing of antenna elements and different feed phase angles.

Log periodic antennas

A log-periodic antenna, (as shown in Figure 8 on page 39) is a variation of the broadside antenna. The radiating elements decrease in length according to the logarithmic function. The design is based on

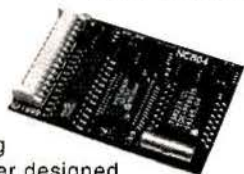
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antenna characteristics that are periodic with the logarithm of the frequency. The variation of the characteristics is small over a single time period, allowing the antenna to operate frequency-independent. In other words, it has an acceptable VSWR over a 2:1 frequency change—the detracting feature is that it has less gain than a Yagi-Uda antenna having the same number of elements, but it is less susceptible to ice buildup. Note the phase reversal of the feed line at each element.

Parasitic array

The multi-element Yagi-Uda antenna was described by S. Uda in Japanese and subsequently in English by H. Yagi. It became first known in the United States as the yagi antenna. A three-element antenna is shown in Figure 9 on page 40 with optimum spacing for forward gain. The longer element is the reflector, and the driven element (that takes power) and the director are shorter. The driven element is the base where all elements are derived from. Its length is found by $492(K)/F(\text{MHz})$, where K is the ratio of diameter to wavelength. The reflector is 5% longer and the director is 5% shorter than the driven element. Optimum spacing is 0.2 wavelengths from reflector to driven element and 0.1 to 0.15 wavelengths between the driven element and the director. A single reflector is all that is required, but additional directors can be added for more gain. Some antennas may have as many as 48 directors, but the contribution of any more than a dozen is so small, it is best to add another full antenna and feed it in phase. The exception would be when insufficient real estate exists to add antennas side by side.

The operation of a Yagi-Uda antenna is based on all elements accepting energy from the driven element and re-radiating in the correct time relationship. Consider a single wave radiating from the driven element. The reflector receives this energy, and it begins to radiate. It does so in the correct time relation-

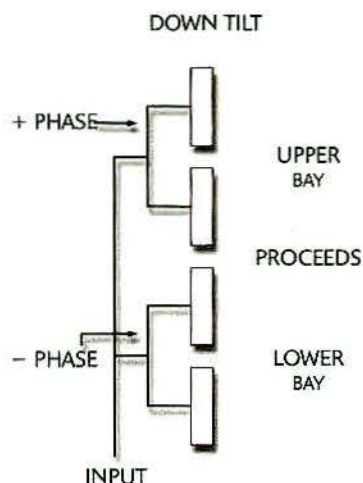


Figure 6. Downtilt.

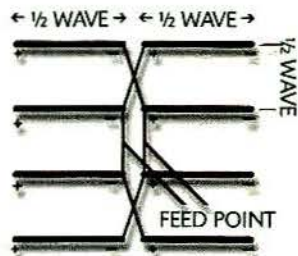


Figure 7. Broadside array.

ship to be in phase with the next wave produced by the driven element. The same contribution is experienced for the directors. They all add in-phase in the forward direction but add out-of-phase in the reverse direction. Anything that modifies the phase relationship directly affects the forward gain and its *front-to-back ratio*. Front-to-back ratio is the energy sent in the forward direction compared to that measured at 180°, and it is expressed in decibels. Ice buildup is one of many factors that alters the performance of the antenna. To make a Yagi-Uda antenna broadband, use large diameter elements, and no more than five. The more directors used, the higher the

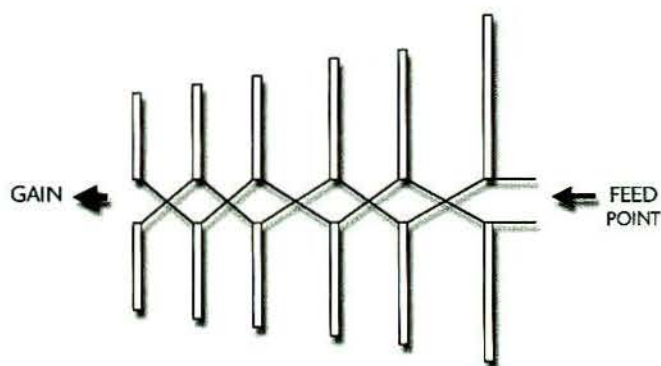


Figure 8. Log periodic antenna.

antenna Q is, resulting in less bandwidth.

Slot antennas

A *slot antenna* is the conjugate of a wire antenna. Figure 10 on page 40 shows a large conductive sheet where a halfwavelength section of material is cut out. The material removed is a half-dipole antenna. The slot, then, is a halfwave antenna, but with reverse properties. Its high impedance point is in the center compared to the dipole with the lowest impedance at the center. Polarization is vertical, and it is a balanced antenna.

When the antenna is rotated to where the slot is vertical, it is now radiating horizontal. Gain is achieved by stacking several in the vertical plane, one above the other. This antenna is the workhorse for the TV broadcast band. It is immune to lightning because its feed point is inside a grounded structure. Another use for the slot antenna is with guided missiles, aircraft and counterintelligence operations where the metal skin of the vehicle is used as the antenna. The slot is filled in with non-conductive resin, painted and completely camouflaged. If the slot antenna is backed with a cavity, it becomes highly directional and does not radiate inside the vehicle. Some texts incorrectly refer to this product as a "pylon antenna."

Parabolic antennas

Figure 11 on page 40 shows a parabolic antenna. It behaves identical to the flashlight. A source of energy at the focal point is re-radiated in the forward direction. The focal point can consist of a simple two-element Yagi-Uda antenna, a horn or an inverse parabolic antenna fed from the center of the larger antenna. The latter is common in space research antennas. For point-to-point microwave, the first two "illuminators" are common. Gain is calculated as $G = 20 \log D + 20 \log F - 52.5$, where D is diameter in feet and F is in megahertz. The industry classifies this antenna at 55% efficiency. If a radome is installed, then the gain figure must be reduced to account for the radome loss.

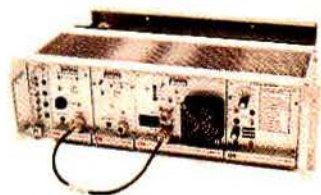
If high-performance antennas are required, a shroud with RF absorbing material is added around the dish to attenuate most of the side-lobe energy and to improve the front-to-back ratio. To the observer, the feed horn is further shielded except for the front of the dish. The reflector can be either solid, grid or mesh screen, depending on the frequency used. The higher the frequency, the tighter the tolerance must be in dish construction. As long as the opening in the material is less than 0.01 wavelengths, it appears as a solid. Vandalism can be a problem because parabolics present attractive



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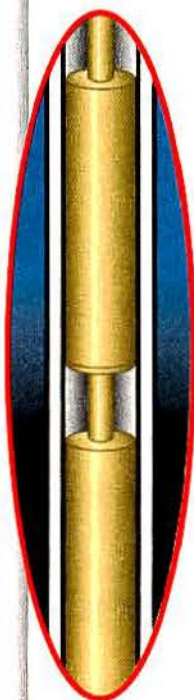
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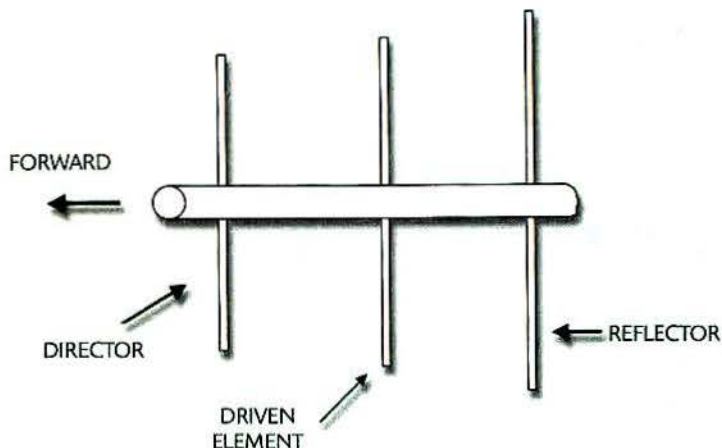
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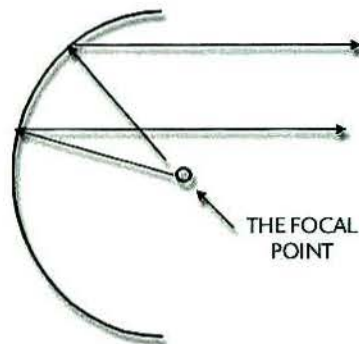
HORIZONTAL
WIRE

THE MATERIAL TAKEN
FROM THE PANEL ABOVE

POLARIZATION
IS VERTICAL

POLARIZATION
IS HORIZONTAL

Figure 9 (top). Yagi-Uda antenna. Figure 10 (middle). The slot antenna has polarity opposite that of the wire. Figure 11 (right). The focal point is where all energy is reflected to. It is a narrow area and is easily missed by damage, often caused by leverage on the rear of the antenna such as waveguide.



targets. At 6GHz, bullet holes contribute little distortion. It's when the feed horn or waveguide is hit that the problem becomes serious. An example is a shipboard radar antenna. Most are constructed of metal screen to reduce wind loading with little reduction in either gain or beam width. Along that line, most navigational radar antennas have little material vertical but large in the horizontal. The large horizontal focuses the beam to be narrow

in the horizontal and large in the vertical. This not only allows accurate bearing measurements but also allows the vessel to rock about vertically and not lose its target. A pencil beam is required for pinpoint accuracy such as fire control radar or speed measuring devices. ■

Part I of "How's Your Antenna" appeared in the August 2001 issue of *Mobile Radio Technology*.

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Ranger Communications acquires SmarTrunk

Ranger Communications, San Diego, had acquired all of the outstanding common shares of SmarTrunk Systems as of July 30.

SmarTrunk Systems will continue to operate under the same name as a wholly owned subsidiary of Ranger Communications, according to a press release. SmarTrunk's sales and technical support departments are to move to new offices in Livermore, CA. John Sullivan, vice president of sales, will continue to head up SmarTrunk's worldwide sales and marketing activities from the Livermore office. Shipping, accounting and administration will

be transferred to National City (San Diego), CA. Manufacturing and engineering operations will be transferred to Taipei, Taiwan.

Eliot Terborgh, founder and chief executive of SmarTrunk, will remain with the company as a consultant during the transition period, but then plans to pursue other business interests. Terborgh stated that while he had mixed feelings about leaving SmarTrunk after 22 years, he has a high degree of confidence in Joe Banos, president of Ranger, and felt that the transaction with Ranger was in the best interests of SmarTrunk's employees, shareholders and customers.

"Ranger is excited about the acquisition of SmarTrunk, which gives us new exposure to the LMR market and broad geographic diversification as a result of SmarTrunk's strong presence overseas," said

Banos. "It is important to note that SmarTrunk's entire sales and technical support staff will remain with the company to make this transaction as seamless as possible for SmarTrunk's customers and employees."

Founded in 1979 as Selectone, SmarTrunk Systems manufactures radio trunking equipment for VHF and UHF radio systems.

Ranger Communications is a subsidiary of Ranger Electronic Communications of Taiwan. Founded in 1972, Ranger is an OEM of marine, citizens band and amateur radio products and accessories. Ranger has factories in Taiwan, China and Malaysia and employs about 700 people. Ranger's U.S. operation is headed by Banos, a 30-year veteran in the design and distribution of products for the land mobile industry.

SmarTrunk Systems will continue to operate under the same name as a wholly owned subsidiary of Ranger.

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PCIA to host dealer seminar at GlobalXChange

During its GlobalXChange 2001 show in Los Angeles to be held Sept. 11-13 (pcia.expoplanner.com), the Personal Communications Industry Association will host a one-day seminar for land mobile radio dealers. This seminar is designed to introduce dealers to revenue and business opportunities outside of traditional dispatch, which can use the dealers' existing

technical personnel and expertise.

The seminar includes sessions on becoming a wireless Internet service provider, strategies for offering residential broadcast services, wireless LANs and becoming a hands-free solution provider. The sessions are designed as basic, introductory, how-to tutorials, according to Alan Tilles of Shulman, Rogers, Gandal, Pordy & Ecker.

Scanning ...

Digitellum, Phoenix, has signed an agreement to equip Chandler Readymix, Decatur, GA, with the Mobius fleet tracking system.

VisionAIR, Wilmington, NC, has signed a contract with Waterford (CT) Public Safety to implement the VisionAIR public safety suite.

The city of O'Fallon, IL, has licensed Troy, MI-based New World Systems' public safety software, including Aegis and Logos.

RELM Wireless has received orders under existing contracts with the Communications Electronics Command of the U.S. Army for \$482,000 and the U.S. Bureau

of Land Management for \$462,000.

The McKim Group, Newton, MA, has been named to represent the full line of PanaVise products in Europe, South America, Africa, Australia and Asia.

Fortney Sales, Kennesaw, GA, has been named manufacturer's representative for BAND-IT. Its sales territory will include Florida and Georgia.

The government of Guam has asked Motorola to rebuild the police department's radio dispatch center and the fire department's 9-1-1 system after Typhoon Paka hit the island more than three years ago.

CIRCLE (36) ON FAST FACT CARD

Scanner selects strongest channel

Thunder Eagle's NOAA weather radio scanner, recorder and communications system interface automatically selects the strongest of seven NWR channels. This scanner digitally records the day and time-

stamps 90-second severe weather warning into the receiver. Severe weather alerts are automatically transmitted on your two-way radio systems without interfering with communica-

tions already in progress. Features of the scanner include DTMF remote control access to warning and live weather through a two-way radio system and through a telephone system. It also automatically sets off your pager and places a severe weather warning on your telephone and voicemail.

WWW.THUNEAGLE.COM



Scanner detects interference

The Grasshopper handheld wireless receiver from **Berkeley Vari-**
tronics Systems is designed for sweeping and optimizing LANs. The instrument measures coverage of direction sequence CDMA networks that operate on the IEEE 802.11b standard. This allows the user to measure and determine the access point, packet error rate and

multipath and RSSI signal levels. This scanner detects and differentiates from narrowband multipath interferences such as microwave ovens and frequency hopping systems. This product features a built-in display, keypad and removable battery pack.

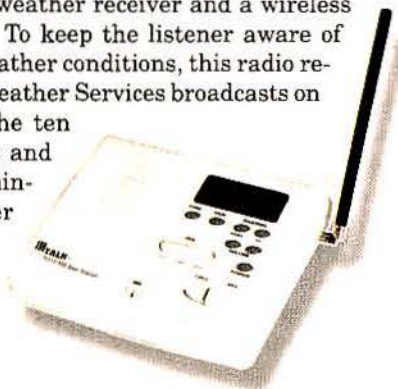
WWW.BVSYSTEMS.COM



Base station offers three functions

Topaz3's TK514 base station offers 14 license-free FRS channels, each with 38 "private talk" codes. The base station's functions include a base-to-radio communicator, a weather receiver and a wireless intercom system. To keep the listener aware of changing local weather conditions, this radio receives National Weather Services broadcasts on one or more of the ten National Oceanic and Atmospheric Administration weather frequencies.

WWW.TOPAZ3.COM



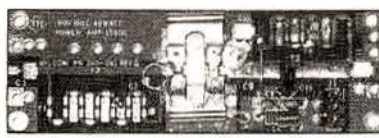
Receiver offers direct control

ICOM America's IC-R8500 base receiver features built-in CI-V and RS-232C for direct computer control, keypad entry, a large backlit LCD and selectable AGC timing. The receiver's frequency covers 100kHz-1,999MHz.

WWW.ICOMAMERICA.COM



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GPS/AVL system holds 85hrs of activity

Pyramid Communications' Merlin is a GPS-based AVL device. It connects to an existing trunking or conventional two-way radio. The device is equipped with three general-purpose inputs and outputs used for vehicle monitoring. It can also store as many as 85 hours of vehicular activity at five-minute update intervals.



WWW.PYRAMIDCOMM.COM OR 714-901-5462

Connector features male coupling



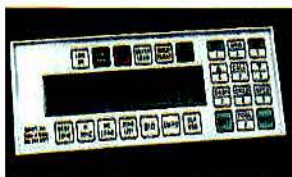
Tru-Connector's 7/16 RF coaxial connectors are available with positive locking and quick-disconnect coupling for hard-to-reach applications. The QD16 coaxial connector features a male cou-

pling with a positive locking, spring-loaded sleeve and integral balls that seat into a corresponding groove on the female to mate securely. This design eliminates the need for threading nuts and tools, and creates a connection that cannot vibrate loose once the sleeve has covered a thin red indicator line. The connectors are constructed with a silver-plated brass body, beryllium-copper contacts and Teflon insulators.

WWW.TRU-CON.COM

Terminal interfaces directly with radio system

The Data Mate 840 from **Wireless Data Solutions** and **DINET** is a full two-way mobile data terminal designed to interface directly with the customer's existing radio system. The terminal is customized to fit with any



radio/wireless infrastructure. The system consists of a mobile data terminal for each vehicle's mobile radio and one central controller for each radio channel or trunking system. Each unit interfaces directly with the existing mobile radio, base radio or cellular device and allows the driver to connect to the fleet's base computer.

WWW.WDSO.NET

Analyzer services batteries simultaneously

The **Cadex** 7400 is a programmable battery analyzer, reconditioner and charger. The product features Quicktest, a program that tests a battery's health in three minutes. Sixteen service programs support routine and



complex tasks. The auto program exercises batteries and reconditions those that fail to meet target capacity settings. The boost program wakes up low-voltage batteries and the prime program formats new batteries. This analyzer handles Li-ion/polymer, NiMH, NiCd and lead-acid chemistries.

WWW.CADEX.COM

Mobile computer uses DVI cable

The Rocky mobile from **AMREL** is a three-piece modular mobile computing system using a DVI cable connection for component-to-component communications. By using a DVI cable, the distance between the display and system units has been extended to 32.8". This allows the system unit to be installed in out-of-the-way locations such as a vehicle's trunk. This system consists of three units: a system unit, a display unit and a backlit 89-key keyboard.

WWW.AMREL.COM



Fleet manager connects to Internet

The **@Road iLM 2500** Internet Location Manager provides connectivity to the @Road Locationsmart network, which combines wireless, positioning and XML technologies with the Internet to power mobile resource management products such as FleetASAP. The product supports FleetASAP features including location, monitoring, messaging, reporting and scheduling. The unit has a smaller form factor.

WWW.ATROAD.COM

Dual-array antennas offer offset patterns

The SD210 and SD235 series of low intermod (-85dBm), VHF, exposed-dipole, external harness, single- and dual-array antennas from **Sinc-lair Technologies** are available with bi-directional, offset or omnidirectional patterns.

WWW.SINCTECH.COM



Test two-way batteries in three minutes



Astratec's Xpresscheck-pro tests a two-way battery's capacity in about three minutes. The battery tester includes multicycle reconditioning, automatic charging and 30-second scanning. The module includes test programs designed to match the parameters of the batteries being tested and identifies battery faults.

WWW.ASTRATEC.CO.UK

Mic fits inside the ear

The **Invisio** bone mic tactical headset from **Television Equipment Associates** is small enough to fit totally inside the ear. Designed for fire and HAZMAT applications, the headset's microphone and receiver are incorporated into a tiny generic earmold, which doesn't interfere with SCBA breathers. Made to fit comfortably, the mic picks up voice vibrations from the jawbone, thus eliminating interference caused by ambient noise. Peripheral hearing is not substantially obstructed.

WWW.SWATHEADSETS.COM

Module offers 100W input power handling

The 100-BC-FFN-20 coaxial directional coupler from **Bird Component Products** offers an input power handling of 100W, a frequency range of 225MHz-400MHz and 20dB coupling. This product's directivity is 25dB minimum.

WWW.BIRDFLA.COM

Antennas hidden inside equipment rack

The Surveillance rack antenna system from **STI-CO Industries** simulates a standard contractor's van rooftop equipment rack. Hidden inside are the antennas. This system offers one antenna per vertical roof stanchion for a total system of as many as six antennas or six bands. The mobile antenna system eliminates the need to mount multiple antennas inside or outside the vehicle and can be installed on any



model van. It can be moved from one vehicle to another to support different looks or requirements, and provides easy upgrade alternatives to existing van installations.

WWW.STI-CO.COM

Mounting equipment attaches to windshield

PanaVise Products' Window-grip deluxe mounts in any vehicle by attaching to the windshield. The mount has an AMPS-compatible mounting plate for mobile phones, hands-free kits, phone-PDA combinations, GPS units and mobile video screens. The mounting plate can tilt 210° and can rotate 360°, which gives either the driver or the passenger optimum positioning control. Because of its

universal applications, the mount and attached electronics can be easily moved from vehicle to vehicle. Manufactured from aircraft-grade aluminum, the shaft extends from 13 1/4" to 18" and is indexed to prevent rotation. A lever firmly locks the shaft to its desired length.

WWW.PANAVISE.COM



Base station available in VHF highband

The S-series base station from **RELM Wireless** is available in VHF high band, UHF and 800MHz models. It is a 50W and 35W, 19" rack mount drawer. The base station can be part of a custom-built full rack system or at component

level for existing systems. The product features PC programming, narrowband and wideband operation. The product has received FCC type acceptance for 30MHz-50MHz and 72MHz-76MHz.

WWW.RELM.COM



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September

11-13: PCIA GlobalXChange, sponsored by the Personal Communications Industry Association, Los Angeles Convention Center, Los Angeles. Contact: 703-739-0300 or www.pcia.expoventure.com.

10-13: CTIA Wireless I.T. & Internet 2001, San Diego Convention Center, San Diego. www.wirelessIT.com.

12-13: C.O.P.S. West, produced by the California Peace Officers' Association, Ontario Convention Center, Ontario, Canada. www.copswest.com.

18: Region 24 National Public Safety Planning Advisory Committee meeting, 5 p.m., Chateau on the Lake Resort, Branson, MO. Contact: Steve Devine, 573-526-6105 or email sdevine@mail.state.mo.us.

19-22: Private Wireless Spectrum Management Conference & Expo, sponsored by Industrial Telecommunications Association, the Council of Independent Communications Suppliers and the USMSS, Grand Hyatt Hotel, Washington. Contact: Ray

Wisniewski at 703-528-5115 or email: ray@ita-relay.com.

November

6-8: Canadian Wireless, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center. Contact: 613-233-4888, ext. 102, or www.cwta.ca.

6-11: Communications Marketing Conference, DoubleTree Hotel Tucson-Reid Park, Tucson, AZ. www.commktga.com.

12-15: AMTEX 2001, sponsored by the American Mobile Telecommunications Association, Wyndham Miami Biscayne Bay, Miami. Contact: 202-331-7773. www.amtausa.org.

12-15: IWTA 2001 Expo, sponsored by the International Wireless Telecommunications Association, Wyndham Miami Biscayne Bay, Miami. www.iwta.org.

16: Radio Club of America Annual Awards Banquet and Technical Symposium, New York, www.radio-club-of-america.org.

2002

February

19-22: NATE, sponsored by the National Association of Tower Erectors, Orlando, FL. Contact: 888-882-5865 or www.natehome.com.

March

7-10: Entelec 2002, George R. Brown Convention Center, Houston. www.entelec.org.

April

24-26: International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. www.iwceconexpo.com.

June

23-26: UTC Telecom, sponsored by UTC, the United Telecom Council, MGM Grand, Las Vegas. www.utc.org.

August

11-15: APCO Conference & Exposition, sponsored by APCO, Opryland Hotel, Nashville, TN. www.apcointl.com.

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Correction

In the August 2001 issue of *MRT*, the "Tuning In" article, "UTC presents Telecom 2001 in Milwaukee," contained an error regarding the winners of product awards. The article stated that "Comverge Technologies, Granger Telecom, Harris, World Wide Packets, Comsearch, Keller and Heckman LLP and Alltec won product awards." While all these companies were contenders for an award, not all were winners. The product award winners were: World Wide Packets, Comsearch, Alligator Communications and Alltec.



Cox

Paul R. Cox, vice president of satellite products/systems and government antennas at Andrew, Orland Park, IL, advances to group president, communication products.



Edwards

Eddie Edwards departs Alcatel's RFS subsidiary as president to join ComScope, Hickory, NC, as executive vice president of strategic development.



Little

David Little leaves Allgon and dB Products to join Kathrein, Scala Division, Medford, OR, as east coast regional sales manager.

The Motorola Trunked Users Group awards the Danny Smith Award to **Pam Montanari**, radio systems manager for Pinellas County, FL.

Gerard Spinelli departs East Coast Microwave, Stoneham, MA, as account manager to join Narda, Hauppauge, NY, as sales engineer.

Dale N. Hatfield, director of the interdisciplinary telecommunications program at the University of Colorado in Boulder, is appointed to the board of directors at Houston-based Crown Castle International.

Alan Shark, president of the American Mobile Telecommunications Association, earns his doctorate degree in public administration from the University of Southern California's Washington Public Policy Center.

David J. Synk leaves Adlex, Marlborough, MA, as vice president of sales and joins Optasite, Worcester, MA, as vice president of sales and marketing.

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* Smartnet Spectra C7 Mobile	535
* Spectra C7 Control Stations	8
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* Centracom Series II Phis consoles complete with CEB	6
* Harris 6 Ghz Digital Microwave system	5 sites

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16	Mot. Radius M130 UHF 2f 40w M44XQC20A3AA w/acc	\$250.00
10	Mot. GM300 UHF 8f 40w M44MC20D3AA w/acc	\$250.00
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3	Mot. P50 Port. H41GNU1120 42-50 Mhz 6w	\$150.00
58	Mot. MTX 900 Privacy Plus 896-941 Mhz H25HFA51B3 w/acc	\$200.00
5	Mot. SM120 Mobiles 450-470 16f 40w M44DGC20C2	\$250.00
8	Mot. SM50 Mobiles 450-470 2f 40w 25khz M44DGC20A2	\$250.00
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91	Mot. Maratrac 450-470 Mhz 110w 16f T74XTA7DA3AK w/acc	\$350.00
5	Mot. Maratrac VHF 16f 110w T73XTA7DA2BK w/acc	\$450.00
1	Mot. Spectra VHF 50w T43KMA7JA9AK w/acc	\$550.00
100	Mot. Spectra 900 Mhz D37KGA5JB5FK	\$185.00
2	Mot. Spectra 900 Mhz 128f 30w D37KMA7JA5DK	\$350.00
34	Mot. Miltek UHF T34JJA3000DK w/acc	\$225.00
90	Mot. STX 800 Mhz Type I, II & conv. H35WPA5170DN	\$150.00
26	Mot. STX 800 Mhz Type I, II & conv. H35WPA5170DN	\$350.00
18	Mot. Visar UHF 450-520 Mhz 16f 4w H05RDD9AA4/H05SDD9AA4 w/acc	\$375.00
60	Mot. Micor 800 Mhz 75w repeater (Solid State PA) C55RCB5103AT no cabinet	\$1,200.00
1	Mot. Micor 42-50 Mhz 100w repeater C71RCB	\$1,500.00
21	Mot. MSF 5000 800 trunked repeater 150w C85CXB5103BT	\$3,950.00
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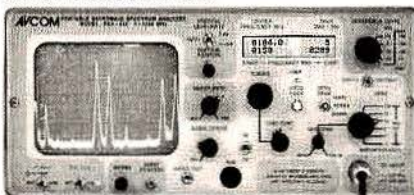
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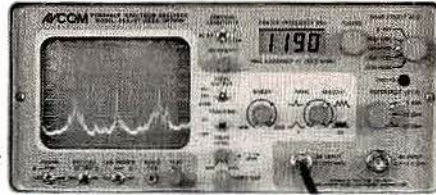
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APCO hosts conference in SLC

APCO session highlights & quotes

The APCO Conference & Exhibition provided a forum for exchanging ideas, opinions and commercials. Following are a few "quotables" *MRT* editors picked up in sessions and on the floor.

Glen S. Nash, incoming APCO president, on efforts to speed the availability of wireless



E9-1-1: "We will continue that fight until it becomes a reality because we know the role in protecting life and property." Nash's other goals: improve APCO's automatic frequency coordination service; help the FCC with its universal licensing service; resolve 800MHz interference; improve frequency coordination with Canada and Mexico; secure spectrum for future needs; and urge members to make plans to use more spectrum efficient systems using Project 25-compliant equipment or other technologies.

Joe L. Hanna, a Dallas-based consultant, cautioned carriers and PSAPs about their potential liability after the Oct. 1 wireless E9-1-1 Phase II deadline, suggesting that carriers that have been asked to provide service but haven't, and that PSAPs receiving cost recovery money without asking carriers for wireless E9-1-1 service, might face lawsuits. "When someone dies, someone wants someone to blame I would not want to be PSAP manager, police or fire chief, mayor or city manager explaining why I'm getting the money, and I didn't ask for wireless E9-1-1," Hanna said.



Pam Montanari, Motorola systems manager for emergency communications in Pinellas County, FL, on the Motorola "Greenhouse" test of high-speed data on a 150kHz-wide 700MHz channel: "Greenhouse is enabling users to do in the field what they previously could only do at their desks." David P. Byrum, a communications engineer with the Pinellas County sheriff's communications maintenance division added: "The county commission wants all departments to work together. Motorola's project is heading the direction of integration that would tie everything together."



David Funk, deputy director at the National Correctional Law Enforcement Technology Center, on 700MHz Regional Planning Committee funding and the center's pre-

coordination database: "So far, we've funded 14 committees that have convened. Someone from each region must come to Denver to learn how to use the database." Among other things, the pre-coordination database helps RPCs to allot FCC-allocated frequencies for city, county and state agencies. The database is programmed to avoid a problem with the 800MHz frequencies: depletion of allotments before tardy RPCs convened.



RoxAnn Brown, chairman of APCO's Project 39, on resolving 800MHz interference from commercial carriers to public safety radio communications systems: "We want to provide multiple, reality-based and,

where possible, tested short-term, mid-term and long-term solutions for 800MHz interference issues." The project's timetable: Within six months, catalog all public safety 800MHz interference issues. Within 12 months, identify and test all potential short-

term interference solutions. Within 18 months, identify and, if possible, test all mid-term and long-term solutions as applied to at least two identified public safety agencies to prove that they work.

John Powell, University of California at Berkeley Police Department, on Project 25 update: "Project 25 Phase I development serves the majority of the U.S. market, which is more sparsely populated. The choice for you depends on your individual components for your system. I think everything on this market will offer you the features you need."

Andrew Terry, director, Minnesota Department of Transportation's Office of Electronic Communications: "With competition, prices are coming down. We are encouraged by other manufacturers participating more ... Before competition, pricing was flat. There was no movement in pricing and no introductions. The high-end radios were running \$3,500." Mary Pittman, marketing manager, Motorola U.S. & Canada Group System Marketing, on what the term Project-25-compliant means: "There are a lot of different types of compliantness. Some are mutually exclusive. It is important that users specify exactly what they want." Dave Helfrich, strategic program manager, APCO 25: "Purchase from multiple vendors, so the prices will go down. Keep doors open, take a look at everybody and keep everybody in business."



Public safety communicators await the opening of the 67th APCO Exposition. More than 275 exhibitors displayed their products and services at the Salt Palace.



APCO's president-elect Thera Bradshaw (above) introduces 9-1-1 for Kids, a program that teaches kids to call 9-1-1 in an emergency. Red E. Fox waves to attendees (left).



TX RX Systems, Angola, NY, celebrates 25 years of business in 2001. Douglas Hillman, general manager, cuts the ceremonial first piece of cake.



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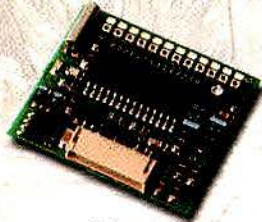
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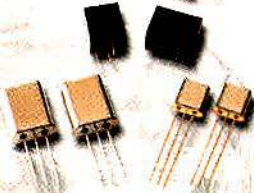
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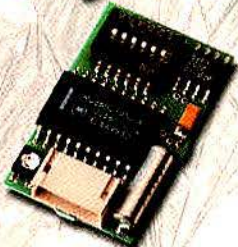
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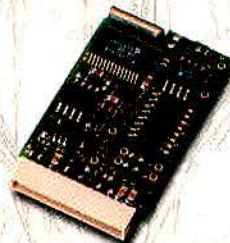
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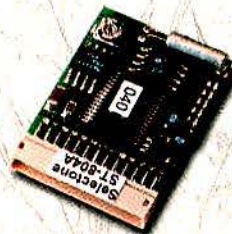
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